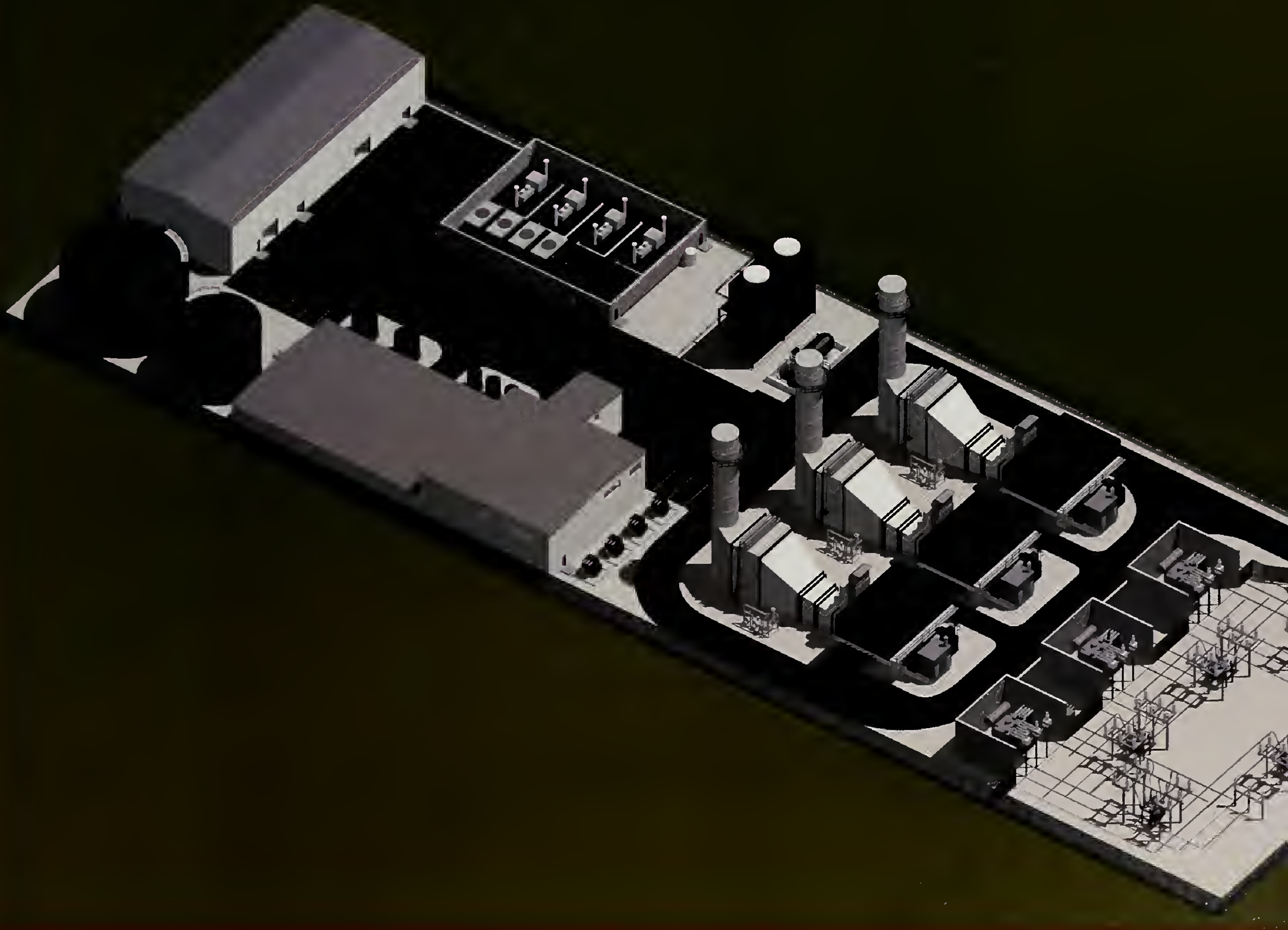
Supplement A

Application for Certification for

San Francisco Electric Reliability Project

Presented to

California Energy Commission
Sacramento, California



Applicant:

City and County of San Francisco

March 2005

SFPUC

WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

SAN FRANCISCO PUBLIC UTILITIES COMMISSION

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GENERAL MANAGER

March 24, 2005

Mr. Robert Therkelsen
Executive Director
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

Dear Mr. ~~Therkelsen~~: Bob

The City and County of San Francisco (the "City") hereby submits this Supplement to the Application for Certification (AFC) for the San Francisco Electric Reliability Project (SFERP), Docket No 04-AFC-01, which was originally filed with the California Energy Commission on March 18, 2004. The Supplement to the AFC for the SFERP has been prepared by the City for the relocation of the project to a 4-acre site of City owned land, located near the San Francisco Bay in the Potrero District of San Francisco.

The SFERP will consist of a nominal 145-megawatt (MW) simple-cycle plant, using three natural gas-fired, General Electric LM 6000 gas turbines and associated infrastructure. The project will employ high efficiency combustion turbine technology and selective catalytic reduction to minimize facility emissions. The project will use recycled water from an onsite treatment plant.

Construction and operation of the SFERP will facilitate the retirement of existing unreliable and highly-polluting in-City generation while maintaining the reliability of the electric system. Prior to the construction of the SFERP, completion of the Jefferson-Martin transmission project, and a number of additional transmission projects that are currently either complete or in progress, will provide for closure of the Hunters Point Power Plant. In addition, the California Independent System Operator has confirmed that construction of the SFERP, in combination with the construction of a number of planned transmission projects and the construction of a small generating facility at the San Francisco International Airport, will provide for the release of units at the Potrero Power Plant from the applicable Reliability-Must-Run (RMR) agreement. Release from the RMR agreement will eliminate a significant source of revenue for continued operation of the units and will allow Mirant Potrero, LLC to shut down the units.

The City is committed to minimizing impacts on the community in Southeast San Francisco, where the SFERP will be located. The City has procured an option for local emission reduction credits to offset NO_x emissions from the SFERP. In addition, the City is developing, with community input, a PM_{10} mitigation/community benefits package to minimize the impacts of the SFERP on residents of San Francisco.

As an official of the City and County of San Francisco, I hereby attest, under penalty of perjury, that the contents of this Supplement to the AFC are truthful and accurate to the best of my knowledge.

Sincerely,

Barbara Hale

Barbara Hale
Assistant General Manager for Power

BH/aw

Therkelsen

Final

Application for Certification for San Francisco Electric Reliability Project Supplement A—Volume 2

DOCUMENTS DEPT.

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Submitted to

California Energy Commission

Applicant

City and County of San Francisco

March 2005

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VOLUME 2: APPENDICES

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The following appendices were provided in Volume 2 of the San Francisco Electric Reliability Project Application for Certification, submitted in March 2003. They have not changed from what was originally submitted. Additional copies of these appendices may be requested from the Applicant.

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APPENDIX 1A

Owners Adjacent to the Project Site and Linear Corridors

Property Owners Around the Plant Site

Block	Lot	Owner	Address	City		Zip Code
4052	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4108	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4108	003	VINCENZO PANEBIANCO	2350 3RD ST	SAN FRANCISCO	CA	94107-3109
4108	003A	CHIU TRS	238 SAN FERNANDO WAY	DALY CITY	CA	94015-2137
4108	003B	F K & T F WONG TRS	2483 35TH AV	SAN FRANCISCO	CA	94116-2247
4108	003C	JAMES E PINE ETAL	355 HILLSBOROUGH BL	HILLSBOROUGH	CA	94010-7039
4108	003D	BRUNO A DAVIS	1308 LASUEN DR	MILLBRAE	CA	94030-2846
4108	003E	PAUL ZINGARO ETAL	999 TENNESSEE ST #A	SAN FRANCISCO	CA	94107-3013
4108	003F	RAEFORD STANBACK	PO BOX 15355	SAN FRANCISCO	CA	94115-0355
4108	003G	MALCOLM S MORRISON	1011 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	003H	GFB PROPERTIES LLC	2400 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	003J	HANLEY TRS	335 MAPLE AV	COTATI	CA	94931-4180
4108	003L	SUREND SHARMA	27824 ORMOND AV	HAYWARD	CA	94544-5020
4108	003M	GEORGE & HELEN G VUREK TRS	2430 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	003N	VAUGHN D KILGORE	2472 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	003o	GFB PROPERTIES LLC	2400 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	003P	SHIMUN DMAR TRS	1001 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	003R	WAYNECO HEAVY INDUSTRIES LLC	PO BOX 5998	INCLINE VILLAGE	NV	89450-5998
4108	004	DOUGLAS E GOWER	2496 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	005	MARVIN LAU ETAL	432 GATEWAY DR #1	PACIFICA	CA	94044-1617
4108	006	ROBERT NOELKE	1074 TENNESSEE ST	SAN FRANCISCO	CA	94107-3016
4108	008	ROBIN HIRSH	1079 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	009	VAUGHN D KILGORE	2472 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	010	EMIL M MERCURI ETAL	232 CLIPPER ST	SAN FRANCISCO	CA	94114-3819
4108	011	JOHN A & BARBARA D KNOX TRS	1483 BACON ST	SAN FRANCISCO	CA	94134-1640
4108	012	JOSEPH BARSOTTI ETAL	PO BOX 1885	MARIPOSA	CA	95338-1885
4108	013	EMMETT & DEBBIE URRUTIA	1053RD	SAN FRANCISCO	CA	94107
4108	014	ECCLESIARCHOU TRS	1049 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	014A	LILTON & MELVIN POWELL	2079 PALOU AV	SAN FRANCISCO	CA	94124-2044
4108	015	GFB PROPERTIES LLC	2400 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	017	FRED H VICKERS	901 TENNESSEE ST	SAN FRANCISCO	CA	94107-3013
4108	018	ELLIS HEFFERNAN TRS	10 VIA DEL ARROYO	NAPA	CA	94559-2104
4108	020	LINDA CATRON	2614 SACRAMENTO ST	SAN FRANCISCO	CA	94115-2237
4108	021	TENNESSEE ST PTNRS	1089 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	022	DANA A BOLSTAD	993 TENNESSEE ST #1	SAN FRANCISCO	CA	94107-3092
4108	023	BOSQUE & SMITH LLC	776 TEHAMA ST	SAN FRANCISCO	CA	94103-3823
4108	024	BOSQUE & SMITH LLC	776 TEHAMA ST	SAN FRANCISCO	CA	94103-3823
4108	025	DARRYL D CHIANG	993 TENNESSEE ST #4	SAN FRANCISCO	CA	94107-3092
4108	026	EVA KIM	993 TENNESSEE ST #5	SAN FRANCISCO	CA	94107-3092
4108	027	BOSQUE & SMITH LLC	776 TEHAMA ST	SAN FRANCISCO	CA	94103-3823
4108	028	MICHAEL PAVES	993 TENNESSEE ST #7	SAN FRANCISCO	CA	94107-3092
4108	029	DARCI N ROSENBLUM	993 TENNESSEE ST	SAN FRANCISCO	CA	94107-3091
4108	030	BOSQUE & SMITH LLC	776 TEHAMA ST	SAN FRANCISCO	CA	94103-3823
4108	031	JOSE J MORALES	993 TENNESSEE ST #10	SAN FRANCISCO	CA	94107-3092
4109	001	ANGELO MARKOULIS	2345 3RD ST	SAN FRANCISCO	CA	94107-3108
4110	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4110	008A	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4111	003	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4111	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4120	002	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4172	001	BALDINI TRS	20 ACORN DR	HILLSBOROUGH	CA	94010-6103
4172	002	MARKY LYNN QUAYLE	2380 BROADWAY ST	SAN FRANCISCO	CA	94115-1234
4172	003	CHARLES A CANEPA ETAL	PO BOX 170218	SAN FRANCISCO	CA	94117-0218
4172	004	INEZ HUNTER TRS	2524 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	005	JAMES T AMOS ETAL	2530 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	006	SCOT & MARIA JENERIK	2538 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	007	IAN HANNULA	2542-2544 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	010	PHILIP J & JEAN E MAKANNA	665 ARKANSAS ST	SAN FRANCISCO	CA	94107-2830
4172	014	LEO TRS	159 SHOOTING STAR ISLE	FOSTER CITY	CA	94404-1805
4172	015	ROBERT C MACPHEE	PO BOX 411567	SAN FRANCISCO	CA	94141-1567
4172	016	THOMAS LUNDBERG ETAL	237 ROSE AV	MILL VALLEY	CA	94941-5033
4172	018	RAUL VILLASENOR	2624 3RD ST	SAN FRANCISCO	CA	94107-3115
4172	018A	TERRYL TAGG ETAL	1195 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	019	ROBERT NOELKE	1074 TENNESSEE ST	SAN FRANCISCO	CA	94107-3016
4172	020	MERCEDES S GARDNER TRS	2638 3RD ST	SAN FRANCISCO	CA	94107-3115
4172	021	ANNE K MILLER	735 HILLCREST WAY	REDWOOD CITY	CA	94062-3453
4172	022	FLYERS LLC	2349 RICKENBACKER WAY	AUBURN	CA	95602-9537
4172	025	THOMAS LUNDBERG ETAL	237 ROSE AV	MILL VALLEY	CA	94941-5033
4172	027	JESUS J NEVAREZ ETAL	1175 ALEMANY BL	SAN FRANCISCO	CA	94112-1401
4172	028	VIRGIE L WINCHESTER	1133-1135 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	029	CHRISTOPHER IRION ETAL	1129 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	032	HENRY BARGERT	8042 VILLA DEL CIELO ST	LAS VEGAS	NV	89131-1657
4172	034	STEVE WELCH ETAL	19031 CARLTON AV	CASTRO VALLEY	CA	94546-2911
4172	034A	BALDINI TRS	20 ACORN DR	HILLSBOROUGH	CA	94010-6103
4172	034B	DOUGLAS E & KATHRYN GOWER	1125 DE HARO ST	SAN FRANCISCO	CA	94107-3210

Property Owners Around the Plant Site

Block	Lot	Owner	Address	City		Zip Code
4172	035	RUDOLPH CHURKA ETAL	686 PARIS ST	SAN FRANCISCO	CA	94112-3512
4172	036	JASON G W FONG ETAL	1109 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	038	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	039	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	041	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	044	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	045	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	046	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	047	PETER FURST TRS	1121 TENNESSEE ST #1	SAN FRANCISCO	CA	94107-3454
4172	048	FRANCISCO R GUERRA	1121 TENNESSEE ST #2	SAN FRANCISCO	CA	94107-3454
4172	049	DANIEL E KAHLER TRS	1121 TENNESSEE ST #3	SAN FRANCISCO	CA	94107-3454
4172	050	KEVIN M MCLEOD	1121 TENNESSEE ST #4	SAN FRANCISCO	CA	94107-3454
4172	051	CHRISTOPHER J DEURIARTE	1121 TENNESSEE ST #5	SAN FRANCISCO	CA	94107-3454
4172	052	JATEEN PAREKH	1121 TENNESSEE ST #6	SAN FRANCISCO	CA	94107-3454
4172	053	REGAN CARROLL	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	054	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	055	2546 THIRD ST LLC	1254 41ST AV	SAN FRANCISCO	CA	94122-1205
4172	056	RAYMOND MILLER	593 TEXAS ST	SAN FRANCISCO	CA	94107-2938
4172	057	JHL LANDS LLC	2546 3RD ST #2	SAN FRANCISCO	CA	94107-3185
4172	058	LINDA LIM	2546 3RD ST #3	SAN FRANCISCO	CA	94107-3185
4172	059	BETTY MICHAEL	2546 3RD ST #4	SAN FRANCISCO	CA	94107-3185
4172	060	VINCENT TOSCANO	2546 3RD ST #5	SAN FRANCISCO	CA	94107-3185
4172	061	BINA MOTIRAM	2546 3RD ST #6	SAN FRANCISCO	CA	94107-3185
4173	001	MARKOULIS ANGELO	2345 3RD ST	SAN FRANCISCO	CA	94107-3108
4175	002	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4175	006	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4175	007	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4230	001	RYDER TRUCK RENTAL INC	PO BOX 25719	MIAMI	FL	33102-5719
4231	002	ROBERT & CARMEN A DELANO TRS	35 EVERGREEN CT	MILLBRAE	CA	94030-1520
4231	004	PARK TRS	1820 SWEETWOOD DR	DALY CITY	CA	94015-2013
4231	005	LIDO MARTOCCHIO	3759 MISSION ST	SAN FRANCISCO	CA	94110-5844
4232	001	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	003	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4232	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4232	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4232	006	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	007	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	008	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	009	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	010	HARRIGAN WEIDENMULLER CO	300 MONTGOMERY ST #800	SAN FRANCISCO	CA	94104-1910
4238	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4239	001	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4239	002	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4240	001	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4240	002	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4241	002	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4241	003	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4241	004	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	002	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	003	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	004	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4245	001	2833 THIRD ST LLC	2833 3RD ST	SAN FRANCISCO	CA	94107-3501
4245	002	JOYCE M FOLEY ETAL	26079 TABLE MEADOW RD	AUBURN	CA	95602-8958
4246	001	JOHN ANTHONY TEDESCO	2800 3RD ST	SAN FRANCISCO	CA	94107-3502
4246	003	EQUILON ENTERPRISES LLC	PO BOX 4369	HOUSTON	TX	77210-4369
4246	004	MARY H LAWSON	1495 TENNESSEE ST	SAN FRANCISCO	CA	94107-3420
4288	003	YELLOW CAB COOPERATIVE INC	1200 MISSISSIPPI ST	SAN FRANCISCO	CA	94107-3436
4288	004	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4288	005	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4288	006	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4290	008	JAFFE TRS	1500 OAK RIM DR	HILLSBOROUGH	CA	94010-7365
4290	010	DENNIS C MAGRI ETAL	148 MARIETTA DR	SAN FRANCISCO	CA	94127-1842
4290	011	JIAN B LIANG	2635 CLEMENT ST #2	SAN FRANCISCO	CA	94121-1819
4290	012	DENNIS C MAGRI ETAL	148 MARIETTA DR	SAN FRANCISCO	CA	94127-1842
4290	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4290	015	JOHN & IDA GIOTTA TRS	300 AVILA ST	SAN FRANCISCO	CA	94123-1106
4290	016	JOHN & IDA GIOTTA TRS	300 AVILA ST	SAN FRANCISCO	CA	94123-1106
4290	017	SAEID MOHEBBI	1455 25TH ST	SAN FRANCISCO	CA	94107-3403
4290	018	PENINSULA CORRIDOR JOINT PWR	1110 PENNSYLVANIA AV	SAN FRANCISCO	CA	94107-7430
4291	015	NORTH RICHMOND PROPERTIES INC	32 WASHINGTON AV	POINT RICHMOND	CA	94801-3945
4291	017	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4291	018	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4296	005	JOSEPHINE DENTONI INC	2820 SUMMIT DR	BURLINGAME	CA	94010-6239
4296	010	JOSEPHINE DENTONI INC	2820 SUMMIT DR	BURLINGAME	CA	94010-6239
4296	013	BRENT K ZERULL TRS	222 SEA VIEW DR	SAN RAFAEL	CA	94901-2352

Property Owners Around the Plant Site

Block	Lot	Owner	Address	City		Zip Code
4296	015	JERRY BARRISH	315 SHORESIDE DR	PACIFICA	CA	94044-3900
4296	016	THIRD AT 25TH LLC	2945 3RD ST	SAN FRANCISCO	CA	94107-3503
4296	017	JERRY BARRISH	315 SHORESIDE DR	PACIFICA	CA	94044-3900
4297	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4298	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4299	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4300	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4301	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4302	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4303	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4304	002	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4308	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4308	006	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4308	007	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4310	003	JOSEPH RATTO TRS	816 COVINGTON RD	BELMONT	CA	94002-1659
4310	004	CALIF STATE-LANDS COMMISSION	PIER 1	SAN FRANCISCO	CA	94111
4313	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4314	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4314	001A	W D & C A SPENCER TRS	99 S HILL DR	BRISBANE	CA	94005-1215
4315	008	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4315	013	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4316	001	TENNESSEE PROPERTIES LLC	3320 JACKSON ST	SAN FRANCISCO	CA	94118-2019
4316	002	WOCO INC	157 7TH AV	SAN FRANCISCO	CA	94118-1206
4317	012	PAOLO & ERIN COSTA	18 APOLLO RD	BEL TIBURON	CA	94920-1302
4317	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4317	015	CURTIS F MITCHELL	1051 26TH ST	SAN FRANCISCO	CA	94107-3512
4317	017	STEINER CORP	505 E S TEMPLE	SALT LAKE CITY	UT	84102-1004
4317	018	STEINER CORP	505 E S TEMPLE	SALT LAKE CITY	UT	84102-1004
4318	011	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	012	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	015	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	017	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4318	018	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4318	022	ANJANETTE Y PONG	1568 INDIANA ST #1	SAN FRANCISCO	CA	94107-3534
4318	023	PAUL WILKENS	1568 INDIANA ST #2	SAN FRANCISCO	CA	94107-3534
4318	024	CHI KIM YOUNG	1568 INDIANA ST #3	SAN FRANCISCO	CA	94107-3534
4318	025	RANDY CORDEIRO	1568 INDIANA ST #4	SAN FRANCISCO	CA	94107-3534
4318	026	JANSEN CHIU ETAL	1568 INDIANA ST #5	SAN FRANCISCO	CA	94107-3534
4318	027	DEBORAH A DEVITA	1568 INDIANA ST #6	SAN FRANCISCO	CA	94107-3534
4318	028	JAMES COHILL	1568 INDIANA ST #7	SAN FRANCISCO	CA	94107-3534
4318	029	GORDON C LYON	1568 INDIANA ST #8	SAN FRANCISCO	CA	94107-3534
4318	030	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	031	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	032	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	033	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	034	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	035	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	036	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	037	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	038	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	039	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	040	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	041	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	042	CHRISTIAN K WREDE	1578 INDIANA ST #1	SAN FRANCISCO	CA	94107-3542
4318	043	RANDY A BALDOVINO	1578 INDIANA ST #2	SAN FRANCISCO	CA	94107-3542
4318	044	JOHN R STALNAKER	1578 INDIANA ST #3	SAN FRANCISCO	CA	94107-3542
4318	045	KOLE B HICKS	1578 INDIANA ST #4	SAN FRANCISCO	CA	94107-3542
4318	046	1578 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	047	DANIEL NORMANDIN	1578 INDIANA ST #6	SAN FRANCISCO	CA	94107-3543
4318	048	FARBOD BARSUM	1578 INDIANA ST #7	SAN FRANCISCO	CA	94107-3543
4318	049	DENISE JEONG	1578 INDIANA ST #8	SAN FRANCISCO	CA	94107-3543
4318	050	AARON CHAICLIN	1578 INDIANA ST #9	SAN FRANCISCO	CA	94107-3544
4318	051	SUSANNA GOLDENSTEIN	1578 INDIANA ST #10	SAN FRANCISCO	CA	94107-3544
4318	052	MICHAEL JOHN GRACE	1578 INDIANA ST #11	SAN FRANCISCO	CA	94107-3544
4318	053	JUSTIN A LEWIS ETAL	1578 INDIANA ST #12	SAN FRANCISCO	CA	94107-3544
4347	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4347	010	HEARST CORP	1901 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1133
4347A	003	SHURARGD STORAGE CENTERS INC	1155 VALLEY ST #400	SEATTLE	WA	98109-4426
4347A	004	SAN FRANCISCO DISTRIBUTION CTR	2201 COLLINS AV	MIAMI BEACH	FL	33139-1717
4349	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	002	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	002A	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	003A	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	003B	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	004	SOUTHERN PAC TRANS CO	1475 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1100

Property Owners Around the Plant Site

Block	Lot	Owner	Address	City		Zip Code
4349	004A	SOUTHERN PAC TRANS CO	1475 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1100
4349	011	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	012	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	013	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	015	FEDERATED METALS CORP	1160 STATE ST	PERTH AMBOY	NJ	08861-2048
4349	016	HEARST CORP	227 W TRADE ST	CHARLOTTE	NC	28202-1675
4352	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4352	006	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4352	007	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4353	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4353	008	YANG'S PROPERTIES LLC	619 35TH AV	SAN FRANCISCO	CA	94121-2709
4353	009	ZHOU H YU ETAL	318 RUSSIA AV #3	SAN FRANCISCO	CA	94112-2732
4355	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4355	006	GAEHWILER TRS	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4356	001	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4356	001A	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4357	003	TED A GOLDSTEIN	900 MARIN ST	SAN FRANCISCO	CA	94124-1217
4357	004	ROBERT M VOGT ETAL	3262 CONGRESSIONAL CIR	FAIRFIELD	CA	94534-7867
4357	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4357	006	MARTIN A GAEHWILER	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4358	007	BART TRUCKING CO	940 81ST AV	OAKLAND	CA	94621-2512
4358	009	BART TRUCKING CO	940 81ST AV	OAKLAND	CA	94621-2512
4358	022	PATTERSON PARTS INC	725 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	023	PATTERSON PARTS INC	745 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	024	R & S ERECTION OF SF INC	715 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	025	ALAN GRINBERG ETAL	707 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	026	JUDITH TICKTIN	275 BARNEVELD AV	SAN FRANCISCO	CA	94124-1318
4377	001	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4378	006	MARTIN GAEHWILER	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4381	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4381	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	003	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4382	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	006	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
9900	080	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102

Property Owners Along the Linear Corridors

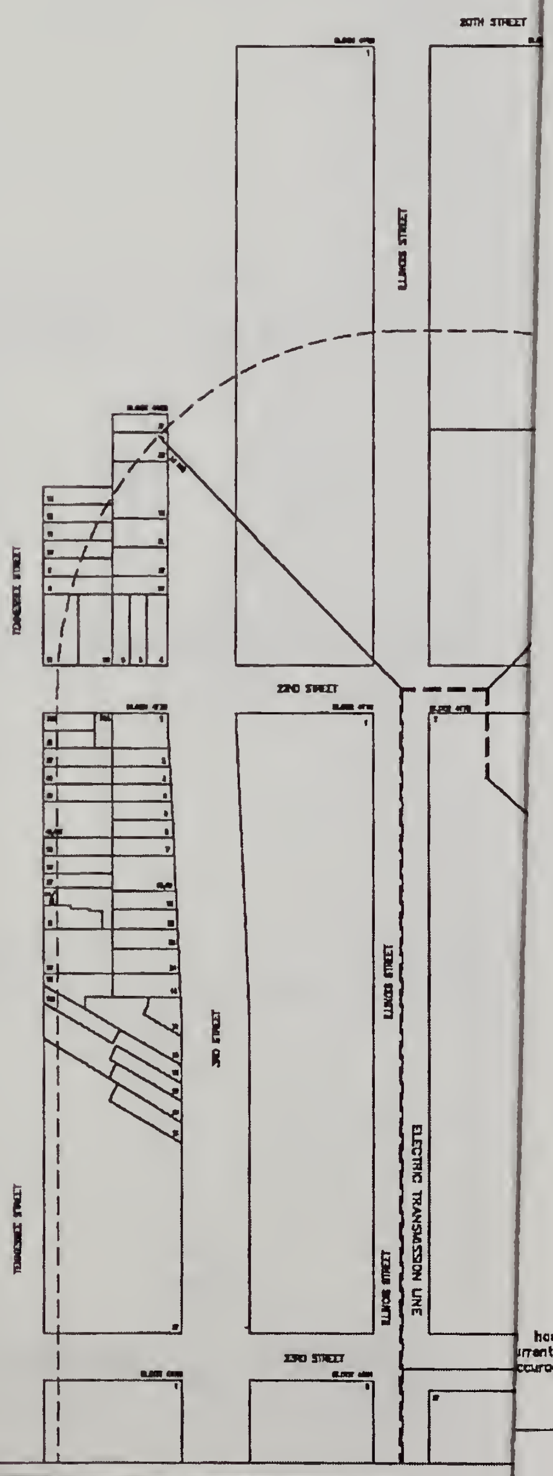
Block	Lot	Owner	Address	City		Zip Code
4052	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4108	003D	BRUNO A DAVIS	1308 LASUEN DR	MILLBRAE	CA	94030-2846
4108	003F	RAEFORD STANBACK	PO BOX 15355	SAN FRANCISCO	CA	94115-0355
4108	003J	HANLEY TRS	335 MAPLE AV	COTATI	CA	94931-4180
4108	003L	SUREND SHARMA	27824 ORMOND AV	HAYWARD	CA	94544-5020
4108	003M	GEORGE & HELEN G VUREK TRS	2430 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	003N	VAUGHN D KILGORE	2472 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	004	DOUGLAS E GOWER	2496 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	005	MARVIN LAU ETAL	432 GATEWAY DR #1	PACIFICA	CA	94044-1617
4108	006	ROBERT NOELKE	1074 TENNESSEE ST	SAN FRANCISCO	CA	94107-3016
4108	008	ROBIN HIRSH	1079 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4108	009	VAUGHN D KILGORE	2472 3RD ST	SAN FRANCISCO	CA	94107-3111
4108	010	EMIL M MERCURI ETAL	232 CLIPPER ST	SAN FRANCISCO	CA	94114-3819
4108	011	JOHN A & BARBARA D KNOX TRS	1483 BACON ST	SAN FRANCISCO	CA	94134-1640
4108	012	JOSEPH BARSOTTI ETAL	PO BOX 1885	MARIPOSA	CA	95338-1885
4108	013	EMMETT & DEBBIE URRUTIA	1053RD	SAN FRANCISCO	CA	94107
4108	020	LINDA CATRON	2614 SACRAMENTO ST	SAN FRANCISCO	CA	94115-2237
4108	021	TENNESSEE ST PTNRS	1089 TENNESSEE ST	SAN FRANCISCO	CA	94107-3015
4109	001	ANGELO MARKOULIS	2345 3RD ST	SAN FRANCISCO	CA	94107-3108
4110	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4110	008A	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4111	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4120	002	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4172	001	BALDINI TRS	20 ACORN DR	HILLSBOROUGH	CA	94010-6103
4172	002	MARKY LYNN QUAYLE	2380 BROADWAY ST	SAN FRANCISCO	CA	94115-1234
4172	003	CHARLES A CANEPA ETAL	PO BOX 170218	SAN FRANCISCO	CA	94117-0218
4172	004	INEZ HUNTER TRS	2524 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	005	JAMES T AMOS ETAL	2530 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	006	SCOT & MARIA JENERIK	2538 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	007	IAN HANNULA	2542-2544 3RD ST	SAN FRANCISCO	CA	94107-3113
4172	010	PHILIP J & JEAN E MAKANNA	665 ARKANSAS ST	SAN FRANCISCO	CA	94107-2830
4172	014	LEO TRS	159 SHOOTING STAR ISLE	FOSTER CITY	CA	94404-1805
4172	015	ROBERT C MACPHEE	PO BOX 411567	SAN FRANCISCO	CA	94141-1567
4172	016	THOMAS LUNDBERG ETAL	237 ROSE AV	MILL VALLEY	CA	94941-5033
4172	018	RAUL VILLASENOR	2624 3RD ST	SAN FRANCISCO	CA	94107-3115
4172	018A	TERRYL TAGG ETAL	1195 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	019	ROBERT NOELKE	1074 TENNESSEE ST	SAN FRANCISCO	CA	94107-3016
4172	020	MERCEDES S GARDNER TRS	2638 3RD ST	SAN FRANCISCO	CA	94107-3115
4172	021	ANNE K MILLER	735 HILLCREST WAY	REDWOOD CITY	CA	94062-3453
4172	022	FLYERS LLC	2349 RICKENBACKER WAY	AUBURN	CA	95602-9537
4172	025	THOMAS LUNDBERG ETAL	237 ROSE AV	MILL VALLEY	CA	94941-5033
4172	027	JESUS J NEVAREZ ETAL	1175 ALEMANY BL	SAN FRANCISCO	CA	94112-1401
4172	028	VIRGIE L WINCHESTER	1133-1135 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	029	CHRISTOPHER IRION ETAL	1129 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	032	HENRY BARGERT	8042 VILLA DEL CIELO ST	LAS VEGAS	NV	89131-1657
4172	034	STEVE WELCH ETAL	19031 CARLTON AV	CASTRO VALLEY	CA	94546-2911
4172	034A	BALDINI TRS	20 ACORN DR	HILLSBOROUGH	CA	94010-6103
4172	034B	DOUGLAS E & KATHRYN GOWER	1125 DE HARO ST	SAN FRANCISCO	CA	94107-3210
4172	035	RUDOLPH CHURKA ETAL	686 PARIS ST	SAN FRANCISCO	CA	94112-3512
4172	036	JASON G W FONG ETAL	1109 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	038	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	039	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	041	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	044	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	045	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	046	REDLAND GROUP INC	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	047	PETER FURST TRS	1121 TENNESSEE ST #1	SAN FRANCISCO	CA	94107-3454
4172	048	FRANCISCO R GUERRA	1121 TENNESSEE ST #2	SAN FRANCISCO	CA	94107-3454
4172	049	DANIEL E KAHLER TRS	1121 TENNESSEE ST #3	SAN FRANCISCO	CA	94107-3454
4172	050	KEVIN M MCLEOD	1121 TENNESSEE ST #4	SAN FRANCISCO	CA	94107-3454
4172	051	CHRISTOPHER J DEURIARTE	1121 TENNESSEE ST #5	SAN FRANCISCO	CA	94107-3454
4172	052	JATEEN PAREKH	1121 TENNESSEE ST #6	SAN FRANCISCO	CA	94107-3454
4172	053	REGAN CARROLL	1155 TENNESSEE ST	SAN FRANCISCO	CA	94107-3416
4172	054	2572-80 THIRD ST LLC	742 4TH AV	SAN FRANCISCO	CA	94118-3913
4172	055	2546 THIRD ST LLC	1254 41ST AV	SAN FRANCISCO	CA	94122-1205
4172	056	RAYMOND MILLER	593 TEXAS ST	SAN FRANCISCO	CA	94107-2938
4172	057	JHL LANDS LLC	2546 3RD ST #2	SAN FRANCISCO	CA	94107-3185
4172	058	LINDA LIM	2546 3RD ST #3	SAN FRANCISCO	CA	94107-3185
4172	059	BETTY MICHAEL	2546 3RD ST #4	SAN FRANCISCO	CA	94107-3185
4172	060	VINCENT TOSCANO	2546 3RD ST #5	SAN FRANCISCO	CA	94107-3185
4172	061	BINA MOTIRAM	2546 3RD ST #6	SAN FRANCISCO	CA	94107-3185
4173	001	MARKOULIS ANGELO	2345 3RD ST	SAN FRANCISCO	CA	94107-3108
4175	006	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4175	007	PAC GAS & ELECTRIC CO	245 MARKET ST	SAN FRANCISCO	CA	94105
4230	001	RYDER TRUCK RENTAL INC	PO BOX 25719	MIAMI	FL	33102-5719

Property Owners Along the Linear Corridors

Block	Lot	Owner	Address	City		Zip Code
4231	002	ROBERT & CARMEN A DELANO TRS	35 EVERGREEN CT	MILLBRAE	CA	94030-1520
4231	004	PARK TRS	1820 SWEETWOOD DR	DALY CITY	CA	94015-2013
4231	005	LIDO MARTOCCHIO	3759 MISSION ST	SAN FRANCISCO	CA	94110-5844
4232	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4232	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4232	009	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4232	010	HARRIGAN WEIDENMULLER CO	300 MONTGOMERY ST #800	SAN FRANCISCO	CA	94104-1910
4239	001	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4239	002	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4240	001	SOUTHERN ENERGY POTRERO LLC	1350 TREAT BL #500	WALNUT CREEK	CA	94597-8853
4240	002	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4241	002	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4241	003	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4241	004	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	002	MARY BATTAINI	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	003	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4244	004	SHEEDY INC	PO BOX 77004	SAN FRANCISCO	CA	94107-0004
4245	001	2833 THIRD ST LLC	2833 3RD ST	SAN FRANCISCO	CA	94107-3501
4245	002	JOYCE M FOLEY ETAL	26079 TABLE MEADOW RD	AUBURN	CA	95602-8958
4246	001	JOHN ANTHONY TEDESCO	2800 3RD ST	SAN FRANCISCO	CA	94107-3502
4246	003	EQUILON ENTERPRISES LLC	PO BOX 4369	HOUSTON	TX	77210-4369
4246	004	MARY H LAWSON	1495 TENNESSEE ST	SAN FRANCISCO	CA	94107-3420
4288	003	YELLOW CAB COOPERATIVE INC	1200 MISSISSIPPI ST	SAN FRANCISCO	CA	94107-3436
4288	004	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4288	005	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4288	006	BAY WEST FALASCHI-COX #1	2 HENRY ADAMS ST #450	SAN FRANCISCO	CA	94103-5000
4290	008	JAFFE TRS	1500 OAK RIM DR	HILLSBOROUGH	CA	94010-7365
4290	010	DENNIS C MAGRI ETAL	148 MARIETTA DR	SAN FRANCISCO	CA	94127-1842
4290	011	JIAN B LIANG	2635 CLEMENT ST #2	SAN FRANCISCO	CA	94121-1819
4290	012	DENNIS C MAGRI ETAL	148 MARIETTA DR	SAN FRANCISCO	CA	94127-1842
4290	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4290	018	PENINSULA CORRIDOR JOINT PWR	1110 PENNSYLVANIA AV	SAN FRANCISCO	CA	94107-7430
4291	017	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4291	018	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4296	005	JOSEPHINE DENTONI INC	2820 SUMMIT DR	BURLINGAME	CA	94010-6239
4296	010	JOSEPHINE DENTONI INC	2820 SUMMIT DR	BURLINGAME	CA	94010-6239
4296	013	BRENT K ZERULL TRS	222 SEA VIEW DR	SAN RAFAEL	CA	94901-2352
4296	015	JERRY BARRISH	315 SHORESIDE DR	PACIFICA	CA	94044-3900
4296	016	THIRD AT 25TH LLC	2945 3RD ST	SAN FRANCISCO	CA	94107-3503
4296	017	JERRY BARRISH	315 SHORESIDE DR	PACIFICA	CA	94044-3900
4297	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4298	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4299	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4300	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4301	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4302	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4304	002	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4308	006	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4310	003	JOSEPH RATTO TRS	816 COVINGTON RD	BELMONT	CA	94002-1659
4310	004	CALIF STATE-LANDS COMMISSION	PIER 1	SAN FRANCISCO	CA	94111
4313	001	CITY & COUNTY OF S F	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102-6051
4314	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4314	001A	W D & C A SPENCER TRS	99 S HILL DR	BRISBANE	CA	94005-1215
4315	008	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4315	013	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4316	001	TENNESSEE PROPERTIES LLC	3320 JACKSON ST	SAN FRANCISCO	CA	94118-2019
4316	002	WOCO INC	157 7TH AV	SAN FRANCISCO	CA	94118-1206
4317	012	PAOLO & ERIN COSTA	18 APOLLO RD	BEL TIBURON	CA	94920-1302
4317	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4317	015	CURTIS F MITCHELL	1051 26TH ST	SAN FRANCISCO	CA	94107-3512
4317	017	STEINER CORP	505 E S TEMPLE	SALT LAKE CITY	UT	84102-1004
4317	018	STEINER CORP	505 E S TEMPLE	SALT LAKE CITY	UT	84102-1004
4318	011	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	012	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	015	MITCHELL & MICHAEL PROPERTIES	1580 INDIANA ST	SAN FRANCISCO	CA	94107-3517
4318	017	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4318	018	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4318	022	ANJANETTE Y PONG	1568 INDIANA ST #1	SAN FRANCISCO	CA	94107-3534
4318	023	PAUL WILKENS	1568 INDIANA ST #2	SAN FRANCISCO	CA	94107-3534
4318	024	CHI KIM YOUNG	1568 INDIANA ST #3	SAN FRANCISCO	CA	94107-3534
4318	025	RANDY CORDEIRO	1568 INDIANA ST #4	SAN FRANCISCO	CA	94107-3534
4318	026	JANSEN CHIU ETAL	1568 INDIANA ST #5	SAN FRANCISCO	CA	94107-3534
4318	027	DEBORAH A DEVITA	1568 INDIANA ST #6	SAN FRANCISCO	CA	94107-3534
4318	028	JAMES COHILL	1568 INDIANA ST #7	SAN FRANCISCO	CA	94107-3534
4318	029	GORDON C LYON	1568 INDIANA ST #8	SAN FRANCISCO	CA	94107-3534

Property Owners Along the Linear Corridors

Block	Lot	Owner	Address	City		Zip Code
4318	030	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	031	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	032	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	033	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	034	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	035	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	036	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	037	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	038	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	039	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	040	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	041	1588 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	042	CHRISTIAN K WREDE	1578 INDIANA ST #1	SAN FRANCISCO	CA	94107-3542
4318	043	RANDY A BALDOVINO	1578 INDIANA ST #2	SAN FRANCISCO	CA	94107-3542
4318	044	JOHN R STALNAKER	1578 INDIANA ST #3	SAN FRANCISCO	CA	94107-3542
4318	045	KOLE B HICKS	1578 INDIANA ST #4	SAN FRANCISCO	CA	94107-3542
4318	046	1578 INDIANA CORP	133 FLYING MIST ISLE	FOSTER CITY	CA	94404-1401
4318	047	DANIEL NORMANDIN	1578 INDIANA ST #6	SAN FRANCISCO	CA	94107-3543
4318	048	FARBOD BARSUM	1578 INDIANA ST #7	SAN FRANCISCO	CA	94107-3543
4318	049	DENISE JEONG	1578 INDIANA ST #8	SAN FRANCISCO	CA	94107-3543
4318	050	AARON CHAICLIN	1578 INDIANA ST #9	SAN FRANCISCO	CA	94107-3544
4318	051	SUSANNA GOLDENSTEIN	1578 INDIANA ST #10	SAN FRANCISCO	CA	94107-3544
4318	052	MICHAEL JOHN GRACE	1578 INDIANA ST #11	SAN FRANCISCO	CA	94107-3544
4318	053	JUSTIN A LEWIS ETAL	1578 INDIANA ST #12	SAN FRANCISCO	CA	94107-3544
4347	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4347	010	HEARST CORP	1901 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1133
4347A	003	SHURARGD STORAGE CENTERS INC	1155 VALLEY ST #400	SEATTLE	WA	98109-4426
4347A	004	SAN FRANCISCO DISTRIBUTION CTR	2201 COLLINS AV	MIAMI BEACH	FL	33139-1717
4349	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	002	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	002A	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	003A	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	003B	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	004	SOUTHERN PAC TRANS CO	1475 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1100
4349	004A	SOUTHERN PAC TRANS CO	1475 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1100
4349	011	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	012	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	013	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4349	014	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4349	015	FEDERATED METALS CORP	1160 STATE ST	PERTH AMBOY	NJ	08861-2048
4349	016	HEARST CORP	227 W TRADE ST	CHARLOTTE	NC	28202-1675
4352	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4352	006	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4352	007	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4353	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4353	008	YANG'S PROPERTIES LLC	619 35TH AV	SAN FRANCISCO	CA	94121-2709
4353	009	ZHOU H YU ETAL	318 RUSSIA AV #3	SAN FRANCISCO	CA	94112-2732
4355	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4355	006	GAEHWILER TRS	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4356	001	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4356	001A	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4357	003	TED A GOLDSTEIN	900 MARIN ST	SAN FRANCISCO	CA	94124-1217
4357	004	ROBERT M VOGT ETAL	3262 CONGRESSIONAL CIR	FAIRFIELD	CA	94534-7867
4357	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4357	006	MARTIN A GAEHWILER	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4358	007	BART TRUCKING CO	940 81ST AV	OAKLAND	CA	94621-2512
4358	009	BART TRUCKING CO	940 81ST AV	OAKLAND	CA	94621-2512
4358	022	PATTERSON PARTS INC	725 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	023	PATTERSON PARTS INC	745 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	024	R & S ERECTION OF SF INC	715 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	025	ALAN GRINBERG ETAL	707 CESAR CHAVEZ	SAN FRANCISCO	CA	94124-1211
4358	026	JUDITH TICKTIN	275 BARNEVELD AV	SAN FRANCISCO	CA	94124-1318
4377	001	WILLIAM D SPENCER ETAL	99 S HILL DR	BRISBANE	CA	94005-1215
4378	006	MARTIN GAEHWILER	1550 MICHIGAN ST	SAN FRANCISCO	CA	94124-1233
4381	001	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	003	CALTRANS	111 GRAND AV	OAKLAND	CA	94612
4382	004	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	005	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102
4382	006	SF REAL ESTATE DEPT	25 VAN NESS AV #400	SAN FRANCISCO	CA	94102



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ccuracy but we do not guarantee it.

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(415) 391-4775

SFERP
MAP 1 OF 3

San Francisco, CA

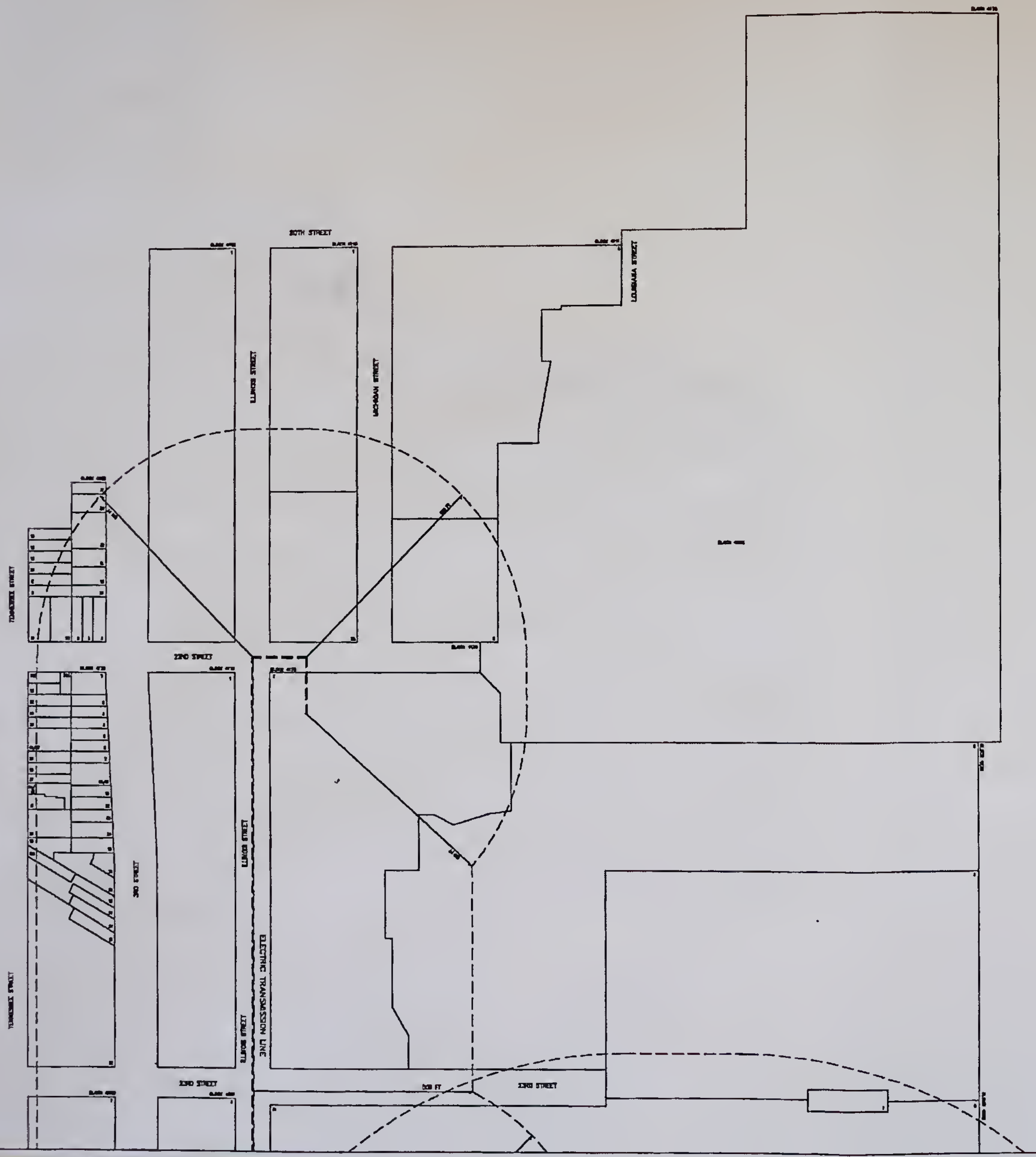
SCALE: 1"=125'0"

[redacted]

[redacted]

JOB NO:	DATE: 050225
430000M	DRAWN: DC
	CHECKED: DC

SFERP SITE
RADIUS MAP



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San Francisco, CA

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[redacted]

JOB NO:	DATE: 050225
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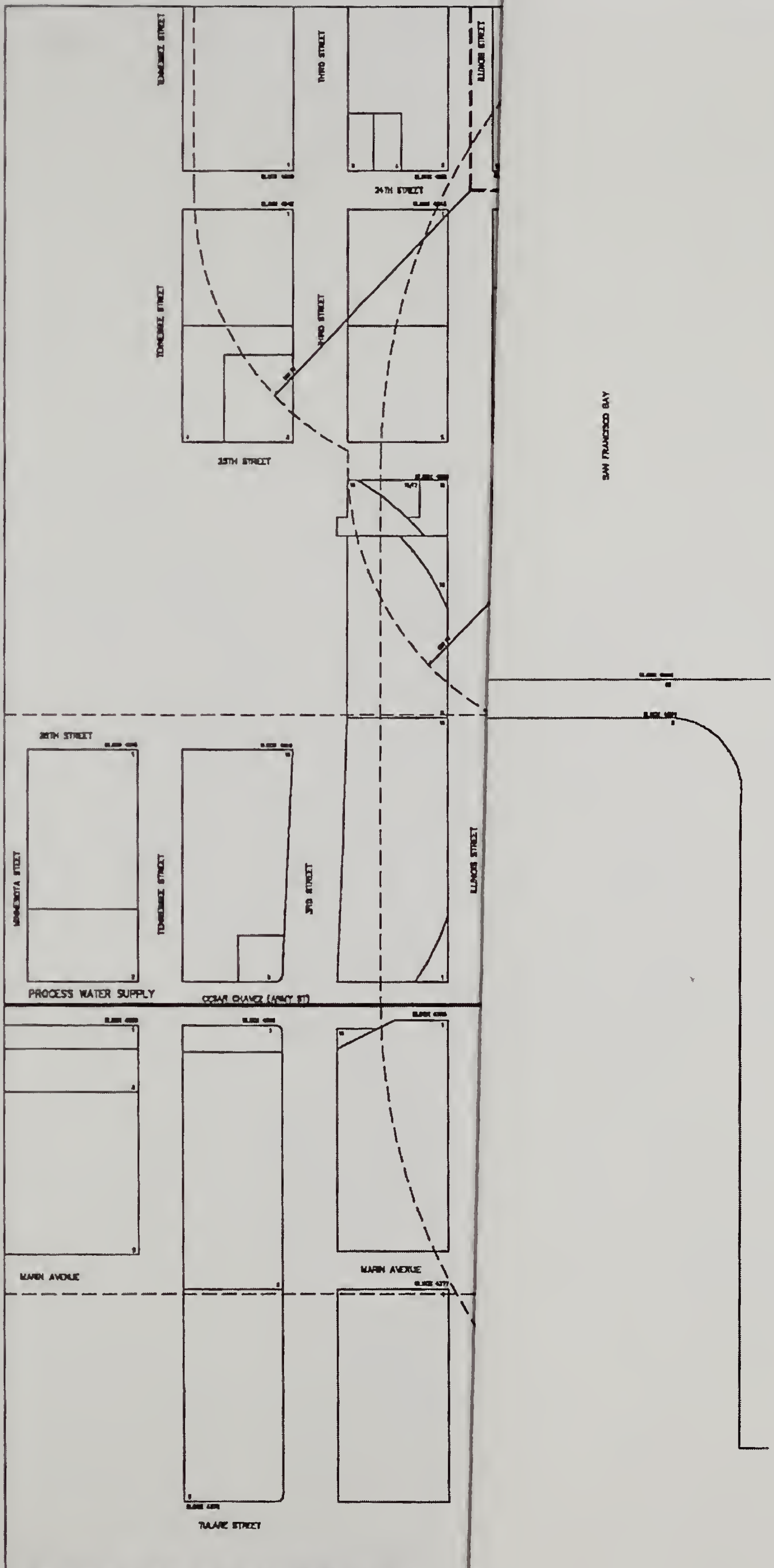
SFERP SITE
RADIUS MAP

[redacted]



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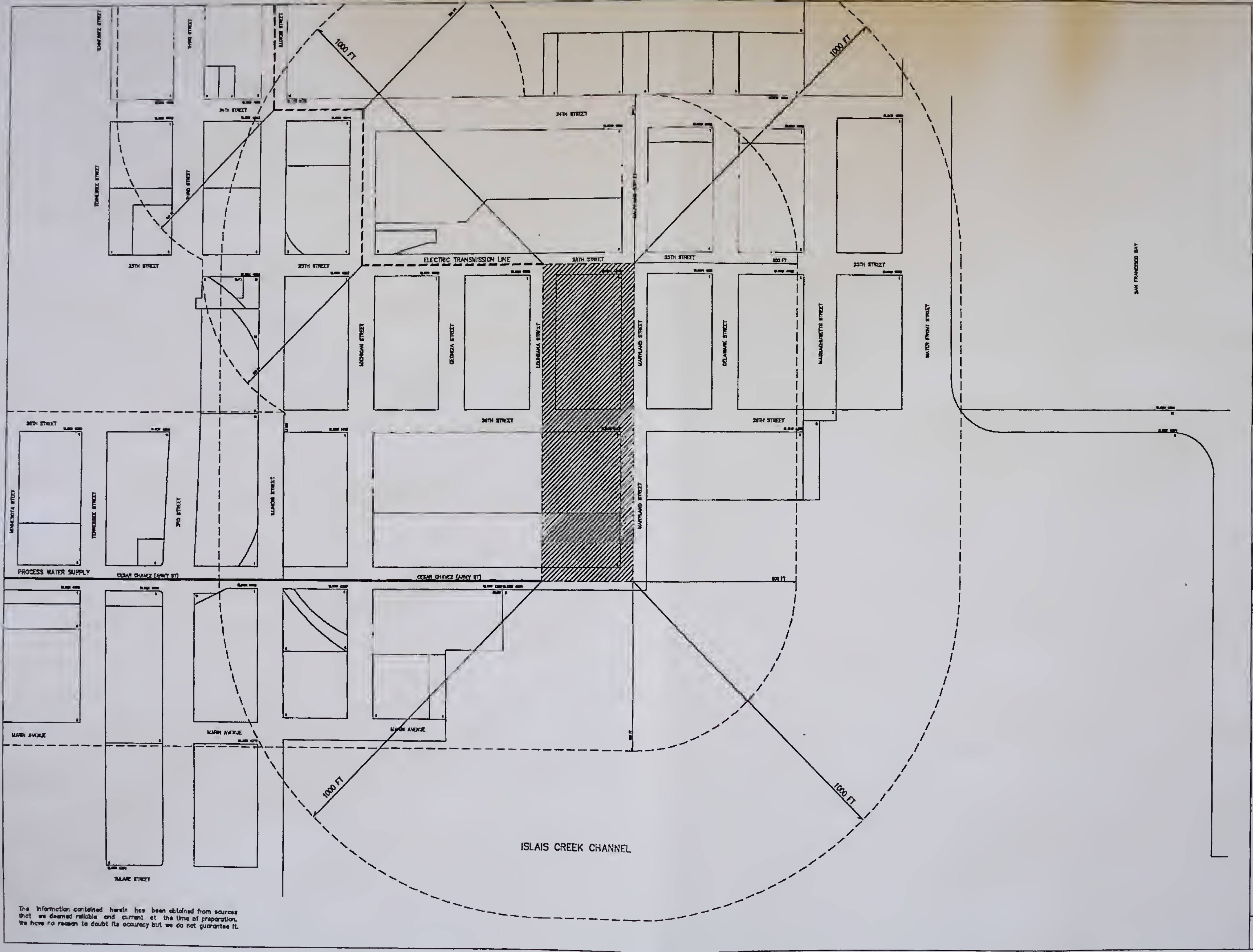
SFERP
MAP 2 OF 3

San Francisco, CA

[redacted]

JOB NO:	DATE: 050225
430000M	DRAWN: DC
	CHECKED: DC

SFERP SITE RADIUS MAP



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MAP 2 OF 3

San Francisco, CA

SCALE 1"=100'-0"

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JOB NO:	DATE: 050225
430000M	DRAWN: DC
	CHECKED: DC

SFERP SITE RADIUS MAP

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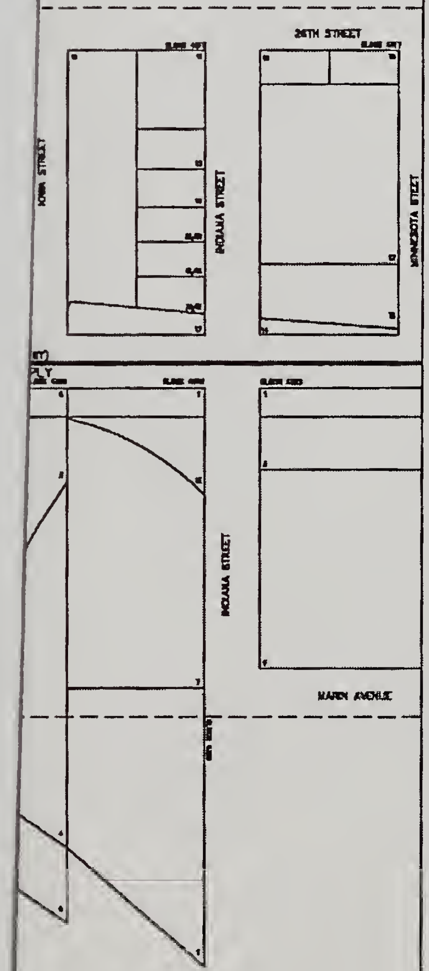

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SFERP
MAP 3 OF 3

San Francisco, CA

N

SCALE 1"=100'-0"

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JOB NO:	DATE: 050225
430000M	DRAWN: DC
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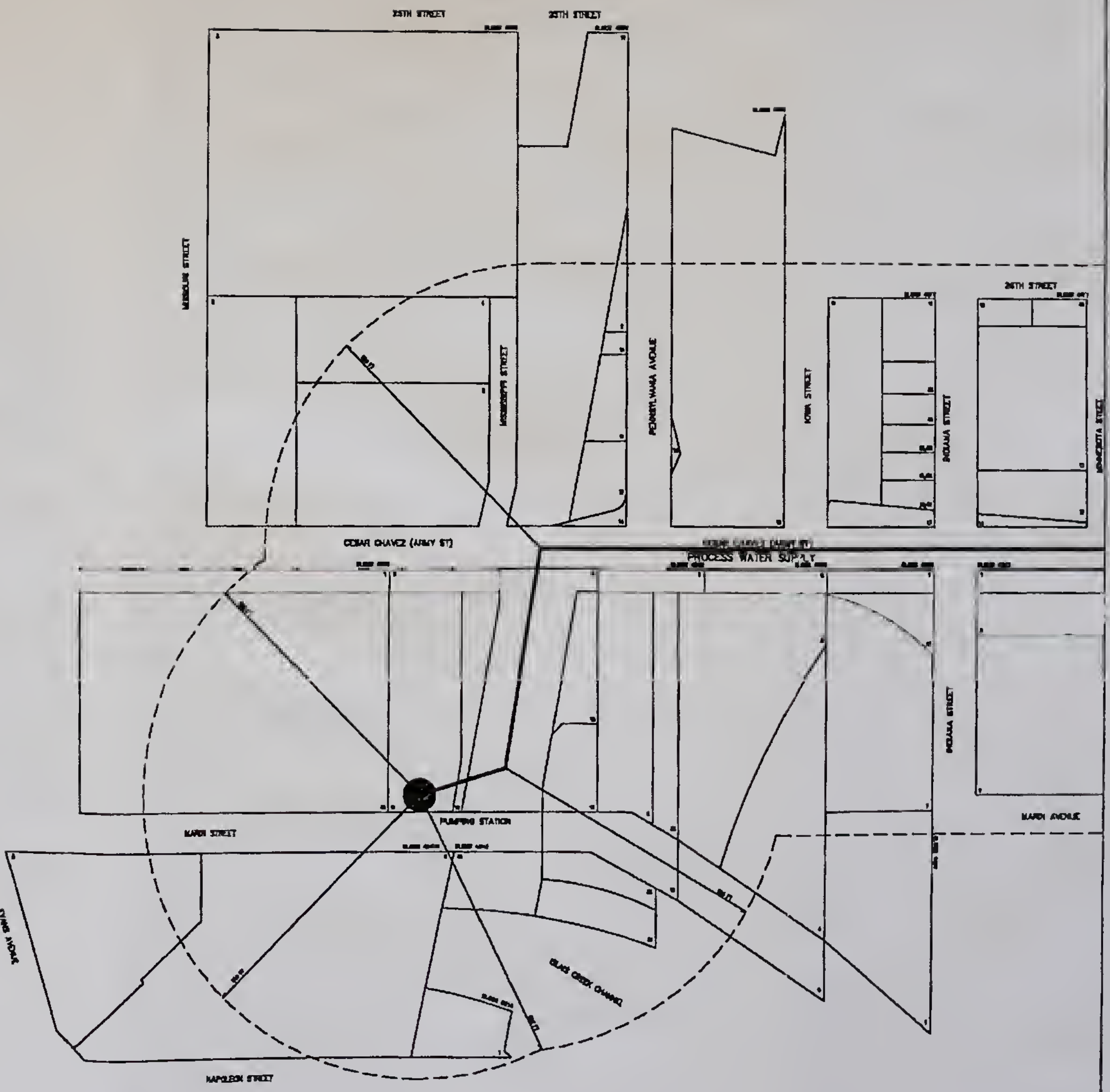
SFERP SITE RADIUS MAP



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SFERP
MAP 3 OF 3

San Francisco, CA

N

SCALE 1"=100'-0"

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JOB NO:	DATE: 050225
430000M	DRAWN: DC
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SFERP SITE
RADIUS MAP

APPENDIX 1B

Persons Who Prepared the AFC

APPENDIX 1B

Persons Who Prepared the AFC

Section	Title	Preparer	Company
	Applicant Project Manager	Karen Kubick	City of San Francisco
	CH2M HILL Project Manager	John Carrier	CH2M HILL
	Environmental Project Manager	Steve De Young	De Young Environmental Consulting
1.0	Executive Summary	Steve De Young	De Young Environmental Consulting
2.0	Project Description	Steve De Young	De Young Environmental Consulting
3.0	Purpose and Need	Barbara Hale and Barry Flynn	City of San Francisco
4.0	Environmental Justice	Anne Eng	City of San Francisco
5.0	Electric Transmission	Steve Brock	PB Power
6.0	Natural Gas Supply	Steve Brock	PB Power
7.0	Water Supply Pipelines	Steve Brock	PB Power
8.0	Environmental Information		
8.1	Air Quality	Gary Rubenstein/ Nancy Matthews	Sierra Research
8.2	Biological Resources	John Cleckler/Debra Crowe	CH2M HILL
8.3	Cultural Resources	Doug Davy	CH2M HILL
8.4	Land Use	Steven Smith	CH2M HILL
8.5	Noise	Mark Bastasch	CH2M HILL
8.6	Public Health	John Lowe	CH2M HILL
8.7	Worker Health and Safety	Trish Danby	CH2M HILL
8.8	Socioeconomics	Fatuma Yusuf/John Carrier	CH2M HILL
8.9	Agriculture and Soils	Steve Long	CH2M HILL
8.10	Traffic and Transportation	Loren Bloomberg	CH2M HILL
8.11	Visual Resources	Wendy Haydon	CH2M HILL
8.12	Hazardous Materials Handling	Karen Parker	CH2M HILL
8.13	Waste Management	Karen Parker	CH2M HILL
8.14	Water Resources	Matt Franck	CH2M HILL
8.15	Geologic Hazards and Resources	Tom Lae	CH2M HILL
8.16	Paleontological Resources	Geof Spaulding	CH2M HILL
9.0	Alternatives	Jerry Salamy, Barbara Hale, Gary Rubenstein, and Steve Brock	CH2M HILL and City of San Francisco
10.0	Engineering	Steve Brock	PB Power

APPENDIX 3A

SFPUC/Energy Efficiency Group Completed Projects as of 2/8/2005

APPENDIX 3A

SFPUC/Energy Efficiency Group Completed Projects as of 2/8/2005

Location	Project	Annual savings MWh / year	Annual savings $/year	Peak demand reduction (kW)	Cost
SFPUC projects					
SF General Hospital, Dept. of Public Health	Lighting system retrofit	2,355	$177,000	700	$1.3 million
SF Housing Authority housing projects	2000 energy-efficient refrigerators	1,228	$92,000	200	$1.1 million
Department Public Health – Clinics	Lighting project (phase 1)	1,500	$100,000	220	$1 million
Golden Gate Park	Rec. & Park Dept. energy efficiency	115	$8,600	29	$76,000
2323 Cesar Chavez DPW/BBR shop	DPW Bureau of Building Repair lighting retrofit	66	$4,900	27	$50,000
West Portal Library	Lighting project	3	$193	8	$22,000
Moscone Convention Center, West Expansion	Energy efficiency	4,658	$343,000	700	$7 million
City-wide traffic lights	LED traffic signals retrofit	7,704	$1.2 million	900	$2.9 million
Moscone Convention Center	Lighting, energy efficiency	4,067	$305,000	800	$4 million
Moscone Convention Center	Solar Photoelectric	826	$60,000	675	$4 million
	Total	**22,522**	**$2,230,693**	**4,259**	**$21.4 million**

APPENDIX 8.1A

Emissions and Operating Parameters

Table 8.1A-1
Emissions and Operating Parameters for New Turbines
San Francisco Electric Reliability Project

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
	36 deg full load, no chilling	59 deg full load, w/chilling	80 deg full load, w/chilling	36 deg 50% load	59 deg 50% load	80 deg 50% load
Ambient Temp, F	36	59	80	36	59	80
GT Load, %	100	100	100	50	50	50
GT heat input, MMBtu/hr (HHV)	484.6	487.3	487.2	273.8	274.0	272.2
Stack flow, lb/hr	1,128,201	1,107,509	1,107,154	745,437	768,865	787,074
Stack flow, dscfm	228,475	222,850	222,710	152,936	158,413	162,980
Stack flow, acfm	619,922	620,308	620,356	412,259	411,857	407,798
Stack temp, F	805	826	826	819	782	744
Stack exhaust, vol %						
O2 (dry)	14.66	14.47	14.46	15.64	15.82	16.00
CO2 (dry)	3.59	3.70	3.70	3.03	2.93	2.83
H2O	10.33	11.18	11.22	8.73	8.16	7.48
Emissions						
NOx, ppmvd @ 15% O2	2.50	2.50	2.50	2.50	2.50	2.50
NOx, lb/hr	4.39	4.41	4.41	2.48	2.48	2.47
NOx, lb/MMBtu	0.0091	0.0090	0.0091	0.0091	0.0091	0.0091
SO2, ppmvd @ 15% O2	0.182	0.182	0.182	0.182	0.182	0.182
SO2, lb/hr	0.45	0.45	0.45	0.25	0.25	0.25
SO2, lb/MMBtu	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092
CO, ppmvd @ 15% O2	4.00	4.00	4.00	4.00	4.00	4.00
CO, lb/hr	4.28	4.30	4.30	2.42	2.42	2.40
CO, lb/MMBtu	0.0088	0.0088	0.0088	0.0088	0.0088	0.0088
VOC, ppmvd @ 15% O2	2.00	2.00	2.00	2.00	2.00	2.00
VOC, lb/hr	1.22	1.23	1.23	0.69	0.69	0.69
VOC, lb/MMBtu	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
PM10, lb/hr	3.0	3.0	3.0	3.0	3.0	3.0
PM10, lb/MMBtu	0.0062	0.0062	0.0062	0.0110	0.0109	0.0110
PM10, gr/dscf	0.00153	0.00157	0.00157	0.00229	0.00221	0.00215
NH3, ppmvd@15% O2	10.0	10.0	10.0	10.0	10.0	10.0
NH3, lb/hr	6.50	6.54	6.53	3.67	3.67	3.65

Table 8.1A-2
Calculation of Cooling Tower Emissions
San Francisco Electric Reliability Project

Cooling Tower Design Parameters	
Water Flow Rate, 10E6 lbm/hr	1.96
Water Flow Rate, gal/min	3,912.0
Drift Rate, %	0.0010
Drift, lbm water/hr	19.55
PM10 Emissions based on TDS Level	
TDS level, ppm	2000
PM10, lb/hr (total, two cells)	0.04
PM10, tpy (total, two cells)	0.17

Table 8.1A-3
Calculation of Annual Fuel Use
San Francisco Electric Reliability Project

487.3	MMBtu/hr of natural gas per turbine at 36 deg F
1,017	Btu/cf
11,700	MMBtu/day of natural gas per turbine
8,760	hours per year of operation per turbine (equivalent)
4,268,700	MMBtu per year of natural gas per turbine
4,197.4	MMcf per year of natural gas per turbine
12,000	hours per year of operation, total, 3 turbines
5,847,600	MMBtu per year of natural gas total
5,750	MMcf per year of natural gas total

Table 8.1A-4
Detailed Calculations for Maximum Hourly, Daily and Annual Criteria Pollutant Emissions
San Francisco Electric Reliability Project

	Base Load			Startup/Shutdown		NOx			SO2	CO			POC		PM10
						Maximum	Ann. Avg.	Startup/Shutdown		Maximum	Ann. Avg.	Startup	Maximum	Startup	
	max. hour	hrs/day	hrs/yr	hrs/day	hrs/yr	lb/hr	lb/hr	lb/hr (1)	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr (1)	lb/hr
Each Turbine	1	20	3750	4	250	4.41	4.41	40.0	0.45	4.30	4.30	10.00	1.23	2.00	3.0

	NOx			SO2			CO			POC			PM10		
	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy	Max lb/hr	Max lb/day	Total tpy
Turbine 1	40.0	248.2	13.3	0.45	10.8	0.9	10.0	126.0	9.3	2.0	32.6	2.6	3.0	72.0	6.0
Turbine 2	40.0	248.2	13.3	0.45	10.8	0.9	10.0	126.0	9.3	2.0	32.6	2.6	3.0	72.0	6.0
Turbine 3	40.0	248.2	13.3	0.45	10.8	0.9	10.0	126.0	9.3	2.0	32.6	2.6	3.0	72.0	6.0
Total, 3 Turbines	120.0	744.6	39.8	1.35	32.3	2.7	30.0	378.0	27.9	6.0	97.8	7.67	9.0	216.0	18.0
Cooling Tower	--	--	--	--	--	--	--	--	--	--	--	--	0.04	0.9	0.2
Facility Total	120.0	744.6	39.8	1.3	32.3	2.7	30.0	378.0	27.9	6.0	97.8	7.7	9.0	216.9	18.2

Table 8.1A-5
Calculation of Noncriteria Pollutant Emissions from Gas Turbines
San Francisco Electric Reliability Project

Compound	Emission Factor, lb/MMscf (2)	Maximum Hourly Emissions, lb/hr Each CTG (3)	Maximum Hourly Emissions, lb/hr Total, 3 CTGs	Total Annual Emissions, 3 CTGs lb/yr	Total Annual Emissions, 3 CTGs tpy
Ammonia	(5)	6.54	19.62	78,480.0	39.2
Propylene	7.71E-01	0.37	1.11	4,433.3	2.2
Hazardous Air Pollutants					
Acetaldehyde	4.08E-02	1.95E-02	5.86E-02	234.6	0.12
Acrolein	3.69E-03	1.77E-03	5.30E-03	21.2	1.06E-02
Benzene	3.33E-03	1.60E-03	4.79E-03	19.1	9.57E-03
1,3-Butadiene	4.39E-04	2.10E-04	6.31E-04	2.5	1.26E-03
Ethylbenzene	3.26E-02	1.56E-02	4.69E-02	187.5	9.37E-02
Formaldehyde	3.67E-01	0.18	0.53	2,110.3	1.06
Hexane	2.59E-01	0.12	0.37	1,489.3	0.74
Naphthalene	1.66E-03	7.95E-04	2.39E-03	9.5	4.77E-03
PAHs (listed individually below)	1.79E-04	8.58E-05	2.57E-04	1.0	5.15E-04
Anthracene	3.38E-05				
Benzo(a)anthracene	2.26E-05				
Benzo(a)pyrene	1.39E-05				
Benzo(b)fluoranthrene	1.13E-05				
Benzo(k)fluoranthrene	1.10E-05				
Chrysene	2.52E-05				
Dibenz(a,h)anthracene	2.35E-05				
Indeno(1,2,3-cd)pyrene	2.35E-05				
Propylene oxide	2.96E-02	1.42E-02	4.25E-02	170.2	0.09
Toluene	1.33E-01	6.37E-02	0.19	764.8	0.38
Xylene	6.53E-02	3.13E-02	0.09	375.5	0.19
Total HAPs			1.35	5,385.4	2.69

Notes:

(1) All factors except PAHs, hexane and propylene from AP-42, Table 3.4-1. Acrolein, benzene and formaldehyde reflect oxidation catalyst. Individual PAHs, hexane and propylene are CATEF mean results as AP-42 does not include factors for these compounds.

(2) Based on maximum hourly turbine fuel use of 487.3 MMBtu/hr and fuel HHV of 1017 Btu/scf. 0.48 MMscf/hr

(3) Based on total annual fuel use of 5,847,600 MMBtu/yr and fuel HHV of 1017 Btu/scf. 5,750.0 MMscf/yr

(4) Based on 10 ppm ammonia slip from SCR system.

Table 8.1A-6
Calculation of Noncriteria Pollutant Emissions from Cooling Tower (1)
San Francisco Electric Reliability Project

Constituent	Concentration in Cooling Tower Return Water	Emissions, lb/hr	Emissions, lb/day	Emissions, ton/yr	BAAQMD TAC Trigger Level, lb/yr
Ammonia	1 ppb	3.91E-08	9.39E-07	3.43E-04	1.93E+04
Arsenic	10 ppb	3.91E-07	9.39E-06	3.43E-03	2.40E-02
Cadmium	1.5 ppb	5.87E-08	1.41E-06	5.14E-04	4.60E-02
Chromium III (2)	6.5 ppb	2.54E-07	6.10E-06	2.23E-03	n/a
Copper	73 ppb	2.85E-06	6.85E-05	2.50E-02	4.63E+02
Lead	12.5 ppb	4.89E-07	1.17E-05	4.28E-03	2.90E+01
Mercury	0.1 ppb	3.91E-09	9.39E-08	3.43E-05	5.79E+01
Nickel	19.5 ppb	7.63E-07	1.83E-05	6.68E-03	7.30E-01
PAHs	0.8 ppb	3.13E-08	7.51E-07	2.74E-04	4.40E-02
PCBs	0.5 ppb	1.96E-08	4.69E-07	1.71E-04	6.80E-03
Zinc	309 ppb	1.21E-05	2.90E-04	1.06E-01	6.76E+03

Note: (1) Emissions calculated from maximum drift rate of 19.55 lb/hr

(2) Speciation of water sample indicates that all chromium is in the form of Cr3. Concentration of Cr6+ is non-detectable at the detection level of RL<0.1 micrograms/liter.

APPENDIX 8.1B

Modeling Analysis

POTRERO POWER PLANT 1992 METEOROLOGICAL DATA SET

1992 WIND FREQUENCY DISTRIBUTION: ANNUAL

WIND SPEED AT 10 M HEIGHT (M/S)

	WIND SPEED (M/S)											
SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	TOTAL
N	38.	129.	177.	98.	29.	9.	0.	0.	0.	0.	0.	480.
NNE	25.	121.	184.	69.	13.	6.	4.	0.	0.	0.	0.	422.
NE	24.	132.	74.	14.	10.	1.	3.	1.	0.	0.	0.	259.
ENE	24.	74.	22.	6.	4.	1.	0.	0.	0.	0.	0.	131.
E	25.	94.	32.	5.	3.	1.	0.	0.	0.	0.	0.	160.
ESE	15.	64.	54.	14.	6.	3.	1.	0.	0.	0.	0.	157.
SE	19.	56.	56.	34.	13.	19.	10.	9.	3.	3.	1.	223.
SSE	30.	62.	70.	63.	41.	56.	36.	26.	5.	7.	0.	396.
S	76.	88.	86.	61.	86.	38.	17.	17.	7.	8.	4.	488.
SSW	48.	83.	48.	31.	22.	7.	1.	1.	0.	0.	0.	241.
SW	81.	230.	238.	183.	43.	12.	3.	0.	0.	0.	0.	790.
WSW	103.	352.	831.	614.	321.	87.	11.	0.	0.	0.	0.	2319.
W	84.	229.	368.	292.	205.	102.	38.	8.	0.	0.	0.	1326.
WNW	60.	137.	147.	180.	107.	55.	24.	9.	1.	0.	0.	720.
NW	70.	103.	70.	41.	28.	3.	0.	0.	0.	0.	0.	315.
NNW	44.	87.	126.	66.	26.	7.	1.	0.	0.	0.	0.	357.
TOTAL	766.	2041.	2583.	1771.	957.	407.	149.	71.	16.	18.	5.	8784.

AVERAGE ANNUAL WIND SPEED (M/S) = 2.813

1992 WIND FREQUENCY DISTRIBUTION: FIRST QUARTER

WIND SPEED AT 10 M HEIGHT (M/S)

	WIND SPEED (M/S)											
SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	TOTAL
N	14.	75.	86.	65.	21.	5.	0.	0.	0.	0.	0.	266.
NNE	16.	57.	130.	54.	6.	3.	2.	0.	0.	0.	0.	268.
NE	15.	56.	48.	8.	5.	1.	0.	1.	0.	0.	0.	134.
ENE	12.	29.	9.	2.	1.	0.	0.	0.	0.	0.	0.	53.
E	13.	23.	8.	1.	0.	0.	0.	0.	0.	0.	0.	45.
ESE	4.	17.	15.	4.	1.	0.	0.	0.	0.	0.	0.	41.
SE	9.	33.	15.	11.	5.	2.	0.	0.	0.	0.	0.	75.
SSE	14.	29.	40.	28.	17.	27.	14.	7.	1.	5.	0.	182.
S	18.	51.	53.	46.	75.	33.	15.	16.	6.	8.	4.	325.
SSW	12.	35.	20.	18.	15.	6.	1.	1.	0.	0.	0.	108.
SW	25.	28.	18.	10.	3.	0.	0.	0.	0.	0.	0.	84.
WSW	17.	33.	31.	9.	6.	1.	0.	0.	0.	0.	0.	97.
W	20.	41.	42.	32.	15.	3.	2.	0.	0.	0.	0.	155.
WNW	15.	45.	29.	29.	16.	9.	1.	1.	0.	0.	0.	145.
NW	29.	23.	23.	20.	16.	3.	0.	0.	0.	0.	0.	114.
NNW	19.	44.	25.	2.	2.	0.	0.	0.	0.	0.	0.	92.
TOTAL	252.	619.	592.	339.	204.	93.	35.	26.	7.	13.	4.	2184.

1992 WIND FREQUENCY DISTRIBUTION: SECOND QUARTER
WIND SPEED AT 10 M HEIGHT (M/S)

	WIND SPEED (M/S)										
SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	TOTAL
N	1.	4.	9.	1.	0.	0.	0.	0.	0.	0.	0.	15.
NNE	0.	7.	14.	6.	0.	0.	0.	0.	0.	0.	0.	27.
NE	0.	14.	7.	1.	0.	0.	0.	0.	0.	0.	0.	22.
ENE	3.	13.	3.	0.	0.	0.	0.	0.	0.	0.	0.	19.
E	1.	16.	6.	0.	0.	0.	0.	0.	0.	0.	0.	23.
ESE	3.	20.	15.	3.	0.	0.	0.	0.	0.	0.	0.	41.
SE	1.	7.	13.	5.	0.	0.	3.	2.	1.	0.	0.	32.
SSE	5.	4.	4.	6.	5.	6.	0.	0.	0.	0.	0.	30.
S	6.	10.	11.	6.	4.	5.	0.	0.	0.	0.	0.	42.
SSW	11.	19.	14.	3.	0.	0.	0.	0.	0.	0.	0.	47.
SW	19.	77.	76.	79.	8.	2.	0.	0.	0.	0.	0.	261.
WSW	18.	86.	218.	255.	167.	60.	6.	0.	0.	0.	0.	810.
W	11.	54.	119.	122.	91.	63.	19.	4.	0.	0.	0.	483.
WNW	6.	27.	60.	78.	52.	34.	18.	8.	1.	0.	0.	284.
NW	4.	6.	8.	8.	2.	0.	0.	0.	0.	0.	0.	28.
NNW	1.	2.	8.	2.	3.	3.	1.	0.	0.	0.	0.	20.
TOTAL	90.	366.	585.	575.	332.	173.	47.	14.	2.	0.	0.	2184.

1992 WIND FREQUENCY DISTRIBUTION: THIRD QUARTER
WIND SPEED AT 10 M HEIGHT (M/S)

	WIND SPEED (M/S)										
SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	TOTAL
N	9.	2.	3.	2.	0.	0.	0.	0.	0.	0.	0.	16.
NNE	4.	6.	12.	1.	0.	0.	0.	0.	0.	0.	0.	23.
NE	3.	24.	7.	0.	0.	0.	0.	0.	0.	0.	0.	34.
ENE	4.	16.	1.	0.	0.	0.	0.	0.	0.	0.	0.	21.
E	4.	18.	3.	0.	0.	0.	0.	0.	0.	0.	0.	25.
ESE	2.	8.	6.	1.	0.	0.	0.	0.	0.	0.	0.	17.
SE	0.	6.	4.	3.	0.	0.	0.	0.	0.	0.	0.	13.
SSE	1.	6.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7.
S	5.	8.	1.	0.	0.	0.	0.	0.	0.	0.	0.	14.
SSW	7.	11.	5.	0.	0.	0.	0.	0.	0.	0.	0.	23.
SW	9.	69.	104.	71.	17.	1.	0.	0.	0.	0.	0.	271.
WSW	14.	143.	501.	303.	128.	26.	5.	0.	0.	0.	0.	1120.
W	25.	68.	138.	102.	83.	34.	17.	4.	0.	0.	0.	471.
WNW	10.	19.	15.	34.	19.	8.	5.	0.	0.	0.	0.	110.
NW	6.	15.	8.	1.	7.	0.	0.	0.	0.	0.	0.	37.
NNW	4.	0.	2.	0.	0.	0.	0.	0.	0.	0.	0.	6.
TOTAL	107.	419.	810.	518.	254.	69.	27.	4.	0.	0.	0.	2208.

1992 WIND FREQUENCY DISTRIBUTION: FOURTH QUARTER

WIND SPEED AT 10 M HEIGHT (M/S)

					WIND SPEED (M/S)						
SECTOR	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10+	TOTAL
N	14.	48.	79.	30.	8.	4.	0.	0.	0.	0.	0.	183.
NNE	5.	51.	28.	8.	7.	3.	2.	0.	0.	0.	0.	104.
NE	6.	38.	12.	5.	5.	0.	3.	0.	0.	0.	0.	69.
ENE	5.	16.	9.	4.	3.	1.	0.	0.	0.	0.	0.	38.
E	7.	37.	15.	4.	3.	1.	0.	0.	0.	0.	0.	67.
ESE	6.	19.	18.	6.	5.	3.	1.	0.	0.	0.	0.	58.
SE	9.	10.	24.	15.	8.	17.	7.	7.	2.	3.	1.	103.
SSE	10.	23.	26.	29.	19.	23.	22.	19.	4.	2.	0.	177.
S	47.	19.	21.	9.	7.	0.	2.	1.	1.	0.	0.	107.
SSW	18.	18.	9.	10.	7.	1.	0.	0.	0.	0.	0.	63.
SW	28.	56.	40.	23.	15.	9.	3.	0.	0.	0.	0.	174.
WSW	54.	90.	81.	47.	20.	0.	0.	0.	0.	0.	0.	292.
W	28.	66.	69.	36.	16.	2.	0.	0.	0.	0.	0.	217.
WNW	29.	46.	43.	39.	20.	4.	0.	0.	0.	0.	0.	181.
NW	31.	59.	31.	12.	3.	0.	0.	0.	0.	0.	0.	136.
NNW	20.	41.	91.	62.	21.	4.	0.	0.	0.	0.	0.	239.
TOTAL	317.	637.	596.	339.	167.	72.	40.	27.	7.	5.	1.	2208.

Table 8.1B-1
Dimensions of On-Site Structures
SFERP

Feature	Height (feet)	Length (feet)	Width (feet)	Diameter (feet)
CTGs				
Combustion turbines & generators (base unit)	14.5	114.4	28.0	--
SCR casings	33	28	18.2	--
Inlet air filters	35.8	59.5	11.2	--
CTG stacks	85	--	--	12
Chiller cooling tower	40	48.6	14.3	--
Tanks				
DI water storage tank	32	--	--	42
Treated water storage tank	32	--	--	60
Aqueous ammonia storage tank	10.0	38.5	18.5	8
Water treatment building	21	149	63.3	--
Admin/control bldg	28	181.6	105.0	--
Future MUNI Maintenance Building	41	549.3	345.5	--

Figure 8.1B-1

Building Layout for GEP Analysis

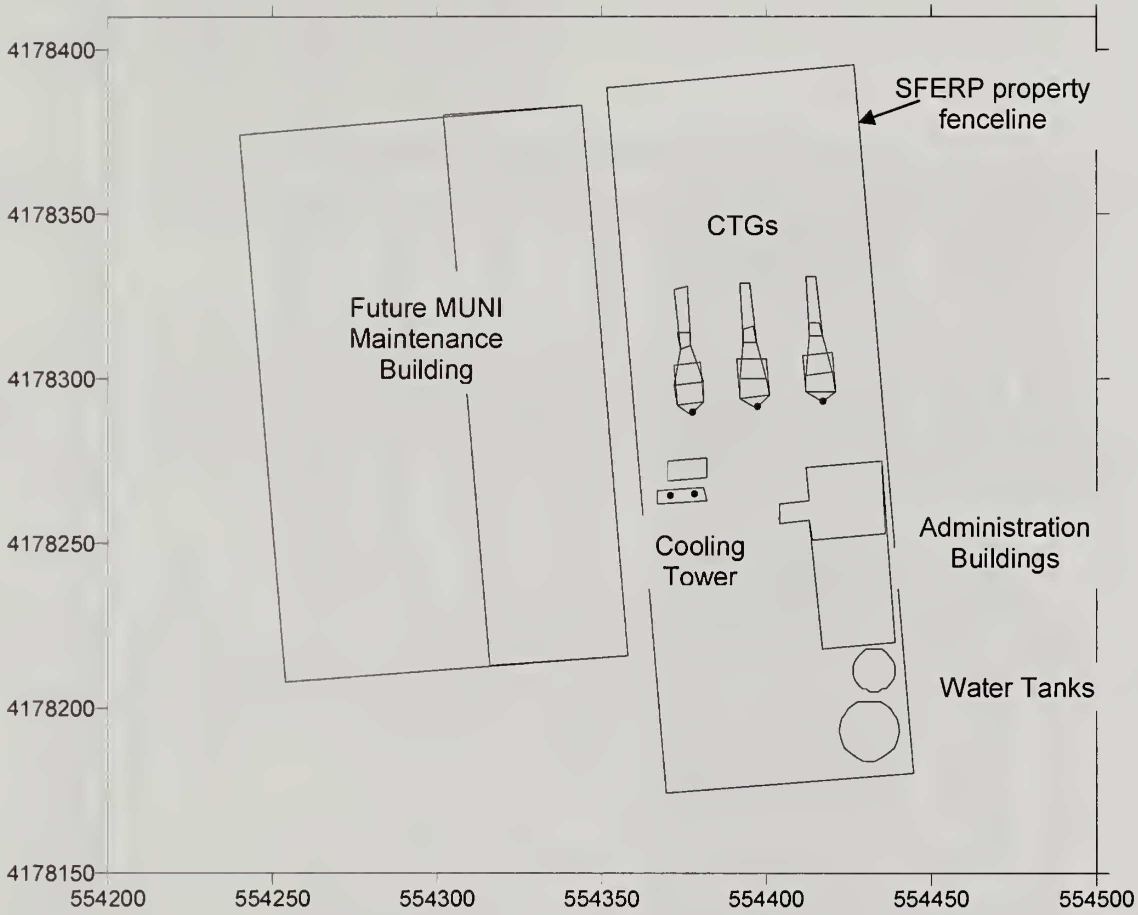


Table 8.1B-2
Emissions and Stack Parameters for Screening Modeling
San Francisco Electric Reliability Project

Turbine Case	Turbine Load, %	Ambient Temp (deg F)	Ambient Temp (deg K)	Stack Diam (m)	Stack Height (m)	Exhaust Temp (deg K)	Exhaust Velocity (m/s)
1	100	36	275.22	3.658	25.908	702.444	27.845
2	100	59	288.00	3.658	25.908	714.111	27.862
3	100	80	299.67	3.658	25.908	714.111	27.865
4	50	36	275.22	3.658	25.908	710.222	18.517
5	50	59	288.00	3.658	25.908	689.667	18.499
6	50	80	299.67	3.658	25.908	668.556	18.317

Note: Parameters are for each turbine.

Table 8.1B-3
Results of the Unit Impact and Turbine Screening Analysis
San Francisco Electric Reliability Project

Turbine Case	Modeled Unit Impact, ug/m3 per 3.0 g/s				
	1-hr	3-hr	8-hr	24-hr	annual
	1992 Potrero Met Data				
1	14.999	10.179	5.820	2.203	0.257
2	14.840	10.080	5.764	2.181	0.254
3	14.839	10.079	5.763	2.181	0.254
4	21.180	13.504	7.720	2.929	0.356
5	21.537	13.698	7.831	2.971	0.362
6	22.089	13.991	7.998	3.035	0.372

Emission Rates by Pollutant and Averaging Period Modeling (lb/hr)												
Turbine Case	NOx			SO2				CO			PM10	
	1-hr	Startup	ann avg	1-hr	3-hr	24-hr	ann avg	1-hr	Startup	8-hr	24-hr	ann avg
1	4.39	--	3.02	0.45	0.45	0.45	0.20	4.28	--	7.14	3.00	1.37
2	4.41	--	3.03	0.45	0.45	0.45	0.20	4.30	--	7.15	3.00	1.37
3	4.41	--	3.03	0.45	0.45	0.45	0.20	4.30	--	7.15	3.00	1.37
4	2.48	40	2.20	0.25	0.25	0.25	0.11	2.42	10	6.21	3.00	1.37
5	2.48	40	2.20	0.25	0.25	0.25	0.12	2.42	10	6.21	3.00	1.37
6	2.47	40	2.20	0.25	0.25	0.25	0.11	2.40	10	6.20	3.00	1.37

Emission Rates by Pollutant and Averaging Period Modeling (g/s)												
Turbine Case	NOx			SO2				CO			PM10	
	1-hr	Startup	ann avg	1-hr	3-hr	24-hr	ann avg	1-hr	Startup	8-hr	24-hr	ann avg
1	0.553	--	0.381	0.056	0.056	0.056	0.026	0.539	--	0.900	0.378	0.173
2	0.556	--	0.382	0.057	0.057	0.057	0.026	0.542	--	0.901	0.378	0.173
3	0.556	--	0.382	0.056	0.056	0.056	0.026	0.542	--	0.901	0.378	0.173
4	0.312	5.04	0.278	0.032	0.032	0.032	0.014	0.305	1.26	0.782	0.378	0.173
5	0.312	5.04	0.278	0.032	0.032	0.032	0.015	0.305	1.26	0.782	0.378	0.173
6	0.311	5.04	0.277	0.032	0.032	0.032	0.014	0.302	1.26	0.781	0.378	0.173

Turbine Case	Load/ Ambient Temp	Modeled Impacts for Three CTGs, ug/m3, by Pollutant and Averaging Period											
		NOx			SO2				CO			PM10	
		1-hr	Startup	Annual	1-hr	3-hr	24-hr	Annual	1-hr	Startup	8-hr	24-hr	Annual
1	100% 36 deg	**8.30**	--	0.098	**0.842**	**0.572**	**0.1237**	**0.00659**	**8.09**	--	5.24	0.83	0.044
2	100% 59 deg w/ chilling	8.25	--	0.097	0.839	0.570	0.1233	0.00655	8.04	--	5.19	0.82	0.044
3	100% 80 deg w/ chilling	8.25	--	0.097	0.838	0.569	0.1232	0.00655	8.04	--	5.19	0.82	0.044
4	50% 36 deg	6.62	106.75	0.099	0.67	0.43	0.093	0.005	6.46	26.69	6.04	1.11	0.061
5	50% 59 deg	6.73	108.54	0.100	0.68	0.43	0.094	0.005	6.57	27.14	6.13	1.12	0.062
6	50% 80 deg	6.87	**111.33**	**0.103**	0.70	0.44	0.096	0.005	6.68	**27.83**	**6.25**	**1.15**	**0.064**

Table 8.1B-4
Emission Rates and Stack Parameters for Refined Modeling
San Francisco Electric Reliability Project

	Stack Diam, m	Stack Height, m	Exh Temp, Deg K	Exhaust Flow, m3/s	Exhaust Velocity, m/s	Emission Rate, g/s			
						NOx	SO2	CO	PM10
Averaging Period: 24 hours, PM10									
Each Turbine	3.658	25.908	668.56	192.46	18.317	n/a	n/a	n/a	3.78E-01
Cooling Towers (each cell)	3.962	12.764	294.11	101.45	8.227	n/a	n/a	n/a	2.46E-03
Averaging Period: Annual, PM10									
Each Turbine	3.658	25.908	668.56	192.46	18.317	n/a	n/a	n/a	1.73E-01
Cooling Towers (each cell)	3.962	12.764	294.11	101.45	8.227	n/a	n/a	n/a	2.46E-03

Table 8.1B-5
Analysis of Impacts due to Inversion Breakup Fumigation
San Francisco Electric Reliability Project

CTG Emission Rates, g/s

	NOx	CO	PM10	SO2
Case 1	0.553	0.539	0.378	0.0562
Case 2	0.556	0.542	0.378	0.0565
Case 3	0.556	0.542	0.378	0.0565
Case 4	0.312	0.305	0.378	0.0317
Case 5	0.312	0.305	0.378	0.0318
Case 6	0.311	0.302	0.378	0.0316

Inversion Breakup Modeling Results from SCREEN3

	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	CO	PM10	SO2	
Case 1	0.9943	0.5500	0.5362	0.3758	0.0558	19,058
Case 2	0.9858	0.5478	0.5341	0.3726	0.0557	19,178
Case 3	0.9857	0.5477	0.5341	0.3726	0.0557	19,179
Case 4	1.313	0.4103	0.4004	0.4963	0.0416	15,545
Case 5	1.333	0.4165	0.4065	0.5039	0.0423	15,373
Case 6	1.364	0.4245	0.4125	0.5156	0.0431	15,117

Flat Terrain Modeling Results from SCREEN3

	Unit Impacts, ug/m3 per g/s	Maximum One-Hour Avg Impacts, ug/m3				Distance to Maximum (m)
		NOx	CO	PM10	SO2	
Case 1	0.6965	0.3853	0.3756	0.2633	0.0391	1201
Case 2	0.6886	0.3826	0.3731	0.2603	0.0389	1205
Case 3	0.6885	0.3826	0.3730	0.2603	0.0389	1205
Case 4	1.006	0.3144	0.3067	0.3803	0.0319	1074
Case 5	1.014	0.3169	0.3092	0.3833	0.0322	1072
Case 6	1.018	0.3168	0.3078	0.3848	0.0321	1072

Adjust unit impacts for longer averaging periods to account for 90-minute duration of fumigation

	1-hr unit	3-hr unit	8-hr unit	24-hr unit
Case 1	0.9943	0.8454	0.7523	0.7151
Case 2	0.9858	0.8372	0.7443	0.7072
Case 3	0.9857	0.8371	0.7442	0.7071
Case 4	1.3130	1.1595	1.0636	1.0252
Case 5	1.3330	1.1735	1.0738	1.0339
Case 6	1.3640	1.1910	1.0829	1.0396

Table 8.1B-5 (cont'd)

Calculation of Fumigation Impacts for Three Units

Case/Avg Period	NOx	CO	PM10	SO2
One-Hour				
Case 1	1.6500	1.6086	-	0.1675
Case 2	1.6433	1.6023	-	0.1671
Case 3	1.6431	1.6022	-	0.1670
Case 4	1.2309	1.2011	-	0.1249
Case 5	1.2496	1.2194	-	0.1270
Case 6	1.2735	1.2374	-	0.1292
3 Hours				
Case 1	-	-	-	0.1282
Case 2	-	-	-	0.1504
Case 3	-	-	-	0.1503
Case 4	-	-	-	0.1124
Case 5	-	-	-	0.1143
Case 6	-	-	-	0.1162
8 Hours				
Case 1	-	0.8520	-	-
Case 2	-	0.8469	-	-
Case 3	-	0.8468	-	-
Case 4	-	0.6810	-	-
Case 5	-	0.6876	-	-
Case 6	-	0.6877	-	-
24 Hours				
Case 1	-	-	0.3244	0.0482
Case 2	-	-	0.3208	0.0480
Case 3	-	-	0.3207	0.0479
Case 4	-	-	0.4650	0.0390
Case 5	-	-	0.4690	0.0394
Case 6	-	-	0.4716	0.0394

NOTES TO TABLE 8.1B-5

INVERSION BREAKUP FUMIGATION ANALYSIS

Inversion breakup fumigation is generally a short-term phenomenon and was evaluated here as persisting for up to 90 minutes. SCREEN3 was used to model one-hour unit impacts from the turbines under 2.5 m/s winds and F stability (for fumigation impacts) and under all meteorological conditions (shown in the table as "Inversion Breakup Modeling Results from SCREEN3").

For longer-term averaging periods, impacts were calculated using the highest modeled impact from SCREEN3 for the corresponding averaging period. A sample calculation for 24-hour average PM_{10} for Case 1 is as follows:

- For a single turbine, Case 1, 1-hour average unit impact = 0.9943 ug/m3 per g/s
- For a single turbine, Case 1, max. 1-hour average unit impact from SCREEN3 = 0.6965 ug/m3 per g/s
- For a single turbine, the appropriate unit impact for the 24-hour averaging period is calculated as 1.5 hours of inversion breakup fumigation plus 22.5 hours of operation under typical conditions (from SCREEN3): [(1.5 * 0.9943 ug/m3 per g/s) + (22.5 * 0.6965 ug/m3 per g/s)] ÷ 24 hrs = 0.7151 ug/m^3 per g/s
- For three turbines with an emission rate of 0.378 g/s, the total 24-hour average PM_{10} impact under inversion breakup fumigation conditions is: 0.7151 ug/m^3 per g/s * 0.378 g/s per turbine* 0.4 [persistence factor for converting 1-hour average screening impact into 24-hour average concentration] * 3 turbines = 0.3244 ug/m^3

Table 8.1B-6
Analysis of Impacts due to Shoreline Fumigation
San Francisco Electric Reliability Project

CTG Emission Rates, g/s

	NOx	CO	PM10	SO2
Case 1	0.553	0.539	0.378	0.056
Case 2	0.556	0.542	0.378	0.057
Case 3	0.556	0.542	0.378	0.056
Case 4	0.312	0.305	0.378	0.032
Case 5	0.312	0.305	0.378	0.032
Case 6	0.311	0.302	0.378	0.032

Shoreline Fumigation Modeling Results from SCREEN3

	Unit Impacts,	Maximum One-Hour Avg Impacts, ug/m3				Distance to
	ug/m3 per g/s	NOx	CO	PM10	SO2	Maximum (m)
Case 1	6.635	3.6701	3.5781	2.5080	0.3726	1683
Case 2	6.572	3.6518	3.5607	2.4842	0.3714	1698
Case 3	6.572	3.6518	3.5607	2.4842	0.3711	1698
Case 4	9.046	2.8267	2.7583	3.4194	0.2869	1256
Case 5	9.2	2.8748	2.8053	3.4776	0.2922	1236
Case 6	9.439	2.9376	2.8544	3.5679	0.2979	1205

Flat Terrain Modeling Results from SCREEN3

	Unit Impacts,	Maximum One-Hour Avg Impacts, ug/m3				Distance to
	ug/m3 per g/s	NOx	CO	PM10	SO2	Maximum (m)
Case 1	0.6965	0.3853	0.3756	0.2633	0.0391	1201
Case 2	0.6886	0.3826	0.3731	0.2603	0.0389	1205
Case 3	0.6885	0.3826	0.3730	0.2603	0.0389	1205
Case 4	1.006	0.3144	0.3067	0.3803	0.0319	1074
Case 5	1.014	0.3169	0.3092	0.3833	0.0322	1072
Case 6	1.018	0.3168	0.3078	0.3848	0.0321	1072

Adjust unit impacts for longer averaging periods to account for three-hour duration of fumigation

	1-hr unit	3-hr unit	8-hr unit	24-hr unit
Case 1	6.6350	6.6350	2.9234	1.4388
Case 2	6.5720	6.5720	2.8949	1.4240
Case 3	6.5720	6.5720	2.8948	1.4239
Case 4	9.0460	9.0460	4.0210	2.0110
Case 5	9.2000	9.2000	4.0838	2.0373
Case 6	9.4390	9.4390	4.1759	2.0706

Table 8.1B-6 (cont'd)

Calculation of Shoreline Fumigation Impacts for Three Units

Case/Avg Period	NOx	CO	PM10	SO2
One-Hour				
Case 1	11.01	10.73	-	1.12
Case 2	10.96	10.68	-	1.11
Case 3	10.96	10.68	-	1.11
Case 4	8.48	8.27	-	0.86
Case 5	8.62	8.42	-	0.88
Case 6	8.81	8.56	-	0.89
3 Hours				
Case 1	-	-	-	1.006
Case 2	-	-	-	1.003
Case 3	-	-	-	1.002
Case 4	-	-	-	0.775
Case 5	-	-	-	0.789
Case 6	-	-	-	0.804
8 Hours				
Case 1	-	3.31	-	-
Case 2	-	3.29	-	-
Case 3	-	3.29	-	-
Case 4	-	2.57	-	-
Case 5	-	2.61	-	-
Case 6	-	2.65	-	-
24 Hours				
Case 1	-	-	0.653	0.097
Case 2	-	-	0.646	0.097
Case 3	-	-	0.646	0.096
Case 4	-	-	0.912	0.077
Case 5	-	-	0.924	0.078
Case 6	-	-	0.939	0.078

NOTES TO TABLE 8.1B-6

SHORELINE FUMIGATION ANALYSIS

Shoreline fumigation was modeled for the turbines using SCREEN3 TIBL factors ranging from 2 to 6 at a distance to shoreline of 280 meters. Based on the analysis of wind persistence in the meteorological data set that was performed by URS for the Potrero 7 project at the same location, shoreline fumigation conditions were assumed to persist for up to 3 hours. For longer-term averaging periods, impacts were calculated using the highest modeled impact from SCREEN3 for the corresponding averaging period. A sample calculation for 24-hour average PM_{10} for Case 3 is as follows:

- For a single turbine, Case 1, 1-hour average unit impact = 6.635 ug/m3 per g/s
- For a single turbine, Case 1, max. 1-hour average unit impact from SCREEN3 = 0.6965 ug/m3 per g/s
- For a single turbine, 24-hour unit impact is calculated as 3 hours of shoreline fumigation plus 21 hours of operation under typical conditions (from SCREEN3): [(3 * 6.635 ug/m3 per g/s) + (21 * 0.6965 ug/m3 per g/s)] ÷ 24 hrs = 1.4388 ug/m^3 per g/s
- For three turbines with an emission rate of 0.378 g/s, the total 24-hour average PM_{10} impact under shoreline fumigation conditions is: 1.4388 ug/m^3 per g/s * 0.378 g/s per turbine* 0.4 [persistence factor for converting 1-hour average screening impact into 24-hour average concentration] * 3 turbines = 0.653 ug/m^3

Table 8.1B-7
Gas Turbine Commissioning Profile
San Francisco Electric Reliability Project

Operating Mode	Hours of Operation(1)	Fuel Use MMBtu/hr (2) (HHV)	Emission Factors (lbs/MMBtu) NOx(3)	CO(4)	VOC(5)	PM10(6)	SOx(7)	Hourly Emissions (lbs/hr) NOx	CO	VOC	PM10
Turbine 1 - FSNL	4	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 2 - FSNL	4	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 3 - FSNL	4	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 1 - Min. Load, no SCR or ox cat	20	96.9	0.15288	0.1501	0.0201	n/a	0.00092	14.82	14.55	1.95	3.0
Turbine 2 - Min. Load, no SCR or ox cat	20	96.9	0.15288	0.1501	0.0201	n/a	0.00092	14.82	14.55	1.95	3.0
Turbine 3 - Min. Load, no SCR or ox cat	20	96.9	0.15288	0.1501	0.0201	n/a	0.00092	14.82	14.55	1.95	3.0
Turbine 1 - FSNL (if necessary)	24	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 2 - FSNL (if necessary)	24	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 3 - FSNL (if necessary)	24	96.9	0.3640	0.2650	0.0755	n/a	0.00092	35.28	25.68	7.32	3.0
Turbine 1 - Multiple Load - Full SCR/ox cat	48	487.3	0.05915	0.0088	0.0025	n/a	0.00092	28.82	4.30	1.23	3.0
Turbine 2 - Multiple Load - Full SCR/ox cat	48	487.3	0.05915	0.0088	0.0025	n/a	0.00092	28.82	4.30	1.23	3.0
Turbine 3 - Multiple Load - Full SCR/ox cat	48	487.3	0.05915	0.0088	0.0025	n/a	0.00092	28.82	4.30	1.23	3.0
Total =	288										

Notes:
(1) Hours of Operation - based on information supplied by MID for the MEGS project.
(2) Fuel Use
  - No Load test: Based on 20% of maximum heat input rating.
  - Minimum Load test: Based on 20% of maximum heat input rating.
  - Multiple Load test: Based on 100% of maximum heat input rating.
(3) NOx Emission Factors
  - No Load test: Based on 100 ppm @ 15% O2.
  - Minimum Load test: Based on maximum uncontrolled emission rate of 42 ppm @ 15% O2.
  - Multiple Load Full SCR/ox cat test: Based on NOx emission levels at the midway point between 30 ppm and 2.5 ppm @ 15% O2.
(4) CO Emission Factors
  - No Load test: Based on maximum uncontrolled emission rate of 30 times controlled level, or 120 ppm @ 15% O2.
  - Minimum Load test: Based on maximum uncontrolled emission rate of 17 times controlled level, or 68 ppm @ 15% O2.
  - Multiple Load Full SCR/ox cat test: Based on unit meeting the project design level of 4 ppm @ 15% O2 with oxidation catalyst installed and operating.
(5) VOC Emission Factors
  - No Load test: Based on maximum uncontrolled emission rate of 30 times controlled level, or 60 ppm @ 15% O2.
  - Minimum Load test: Based on maximum uncontrolled emission rate of 8 times controlled level, or 16 ppm @ 15% O2.
  - Multiple Load Full SCR/ox cat test: Based on unit meeting the project design level of 2 ppm @ 15% O2 with oxidation catalyst installed and operating.
(6) PM10 Emission Factors
  - For all tests, based on project design PM10 level of 3.0 lbs/hr.
(7) SOx Emission Factors
  - For all tests, based on annual average natural gas sulfur content of 0.33 gr/100 scf.

Figure 8.1B-2

Layout of the Receptor Grids

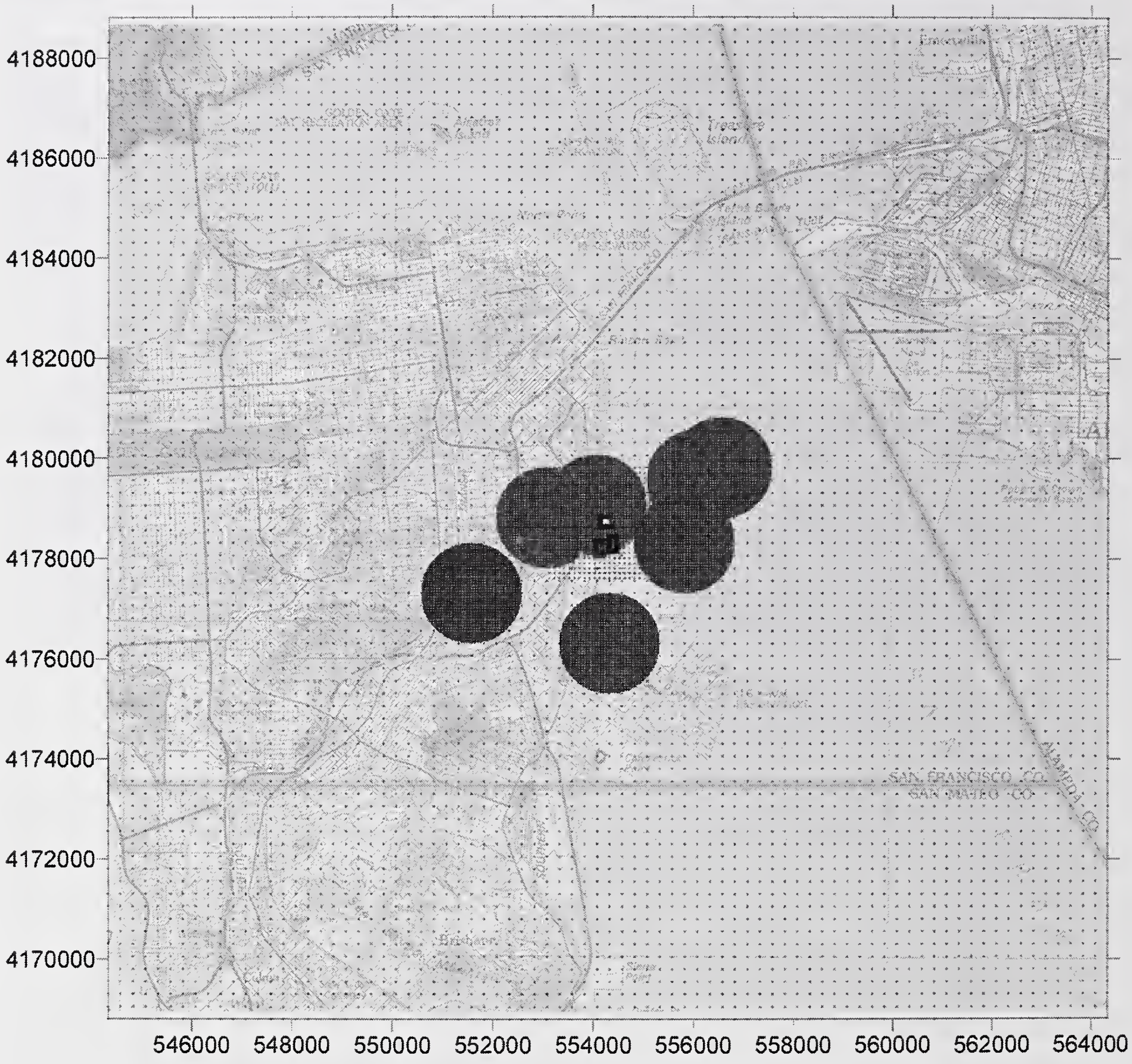
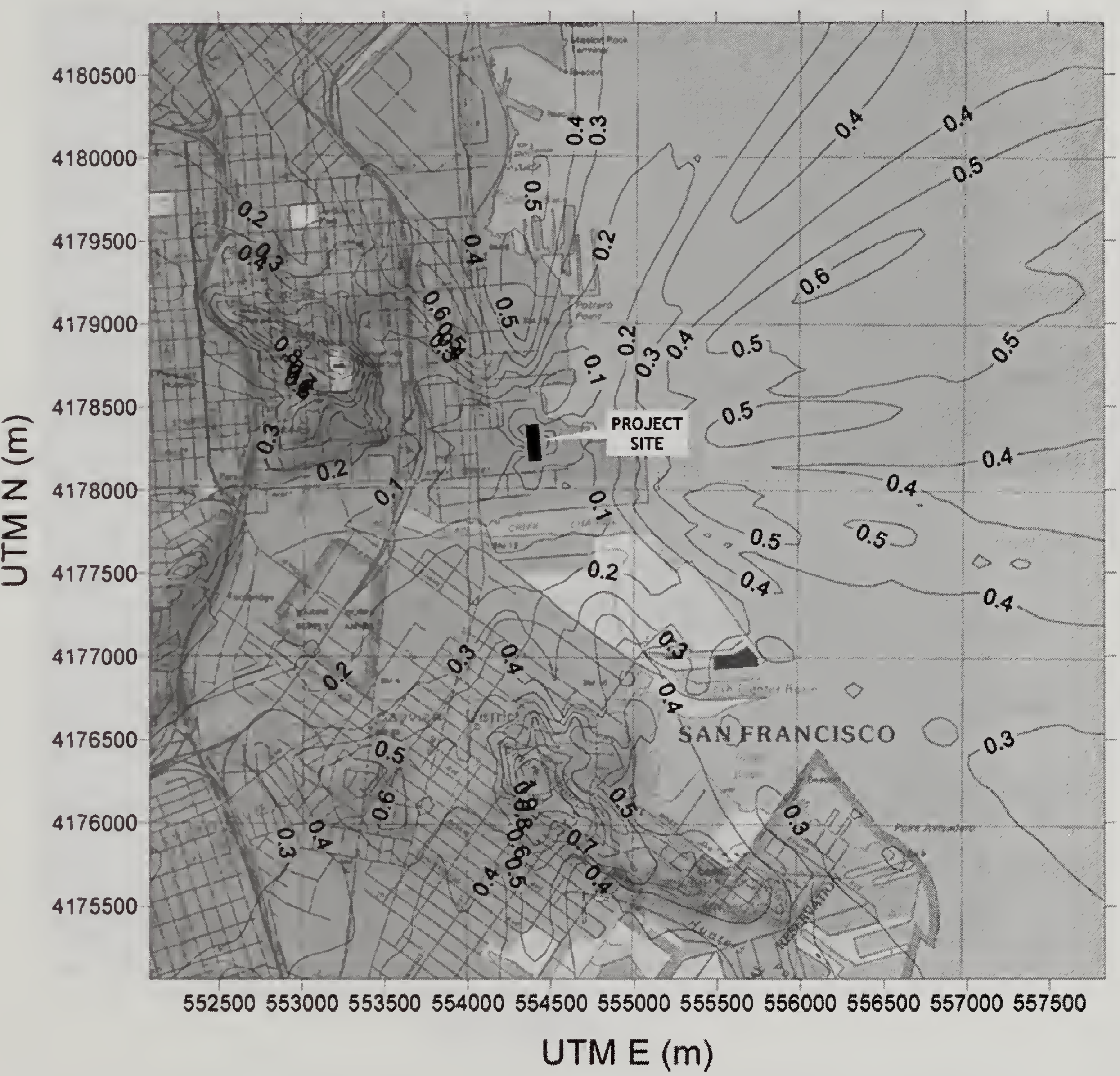


Figure 8.1B-3

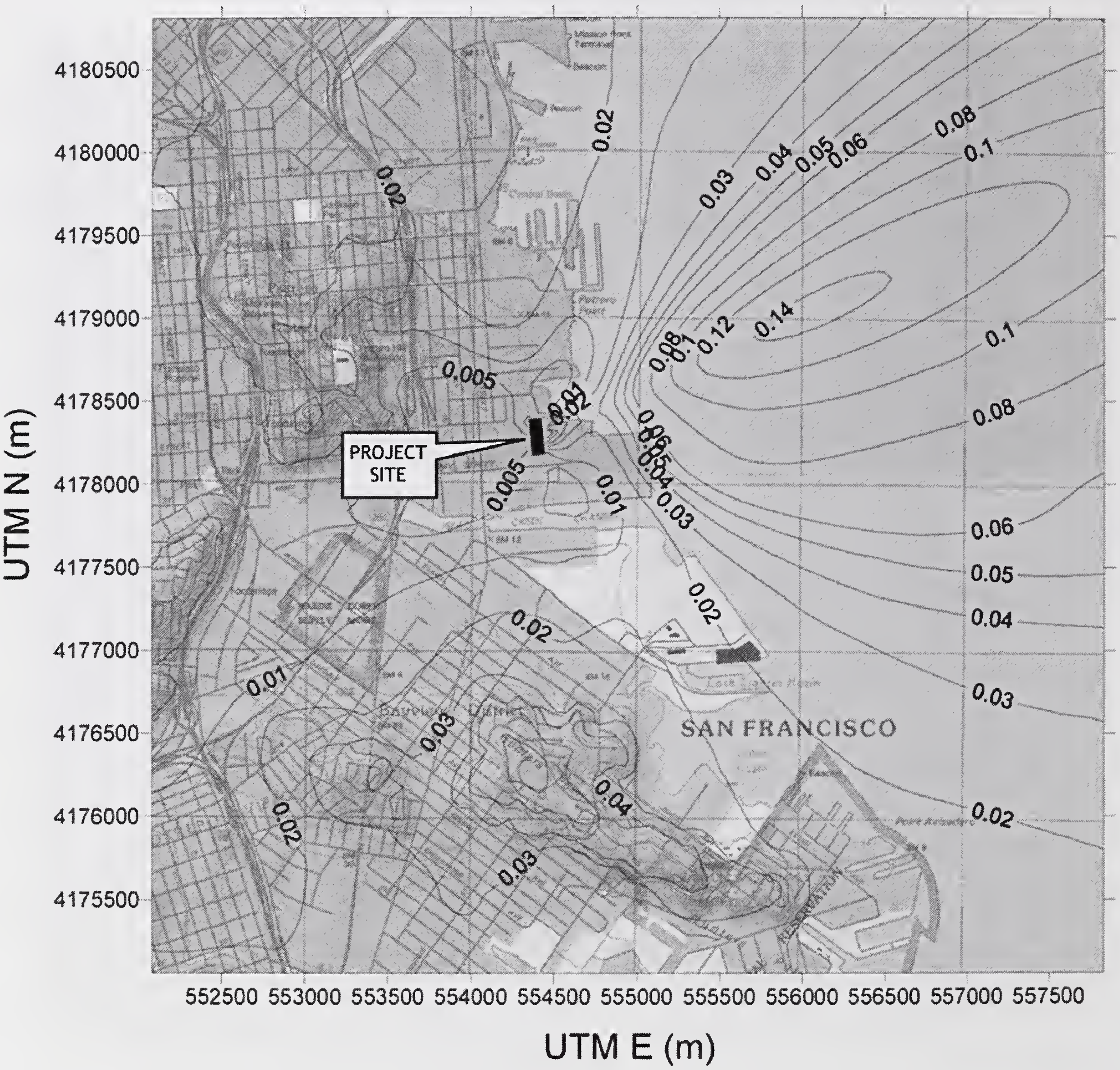
Maximum 24-Hour Average PM_{10} Impacts During Project Operation



Units are µg/m³.

The highest concentration of PM_{10} from the project under any conditions will be 1.2 µg/m³. The concentration considered by the US EPA to be significant is 5 µg/m³. Therefore, the highest concentration of PM_{10} from this project is less than ¼ of the level considered by EPA to be significant.

Figure 8.1B-4
Annual Average PM_{10} Impacts During Project Operation

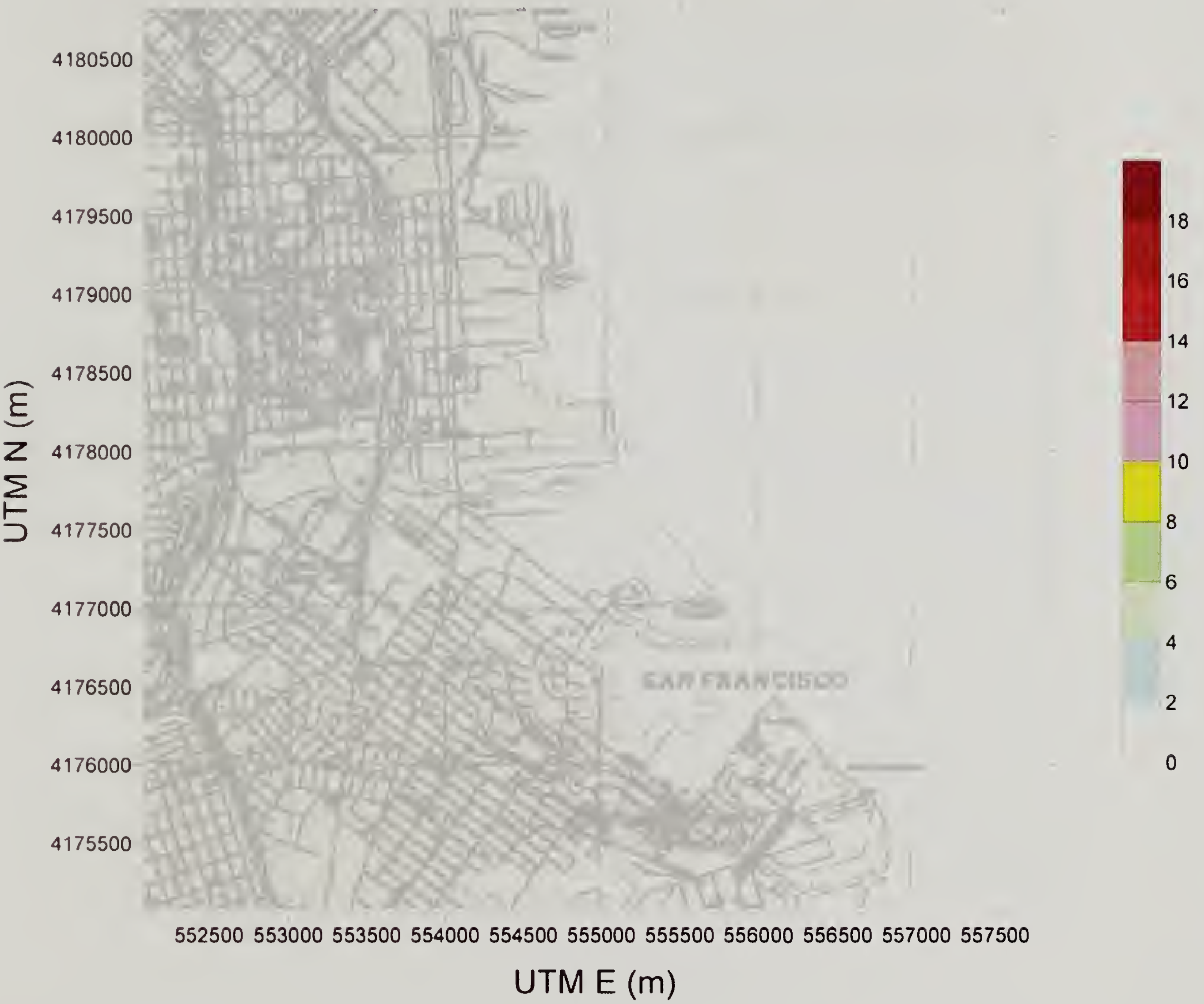


Note: Units are ug/m³.

The highest concentration of PM_{10} from the project under any conditions will be 0.2 µg/m³. The concentration considered by the US EPA to be significant is 1 µg/m³. Therefore, the highest concentration of PM_{10} from this project is less than one-fifth of the level considered by EPA to be significant.

Figure 8.1B-5a

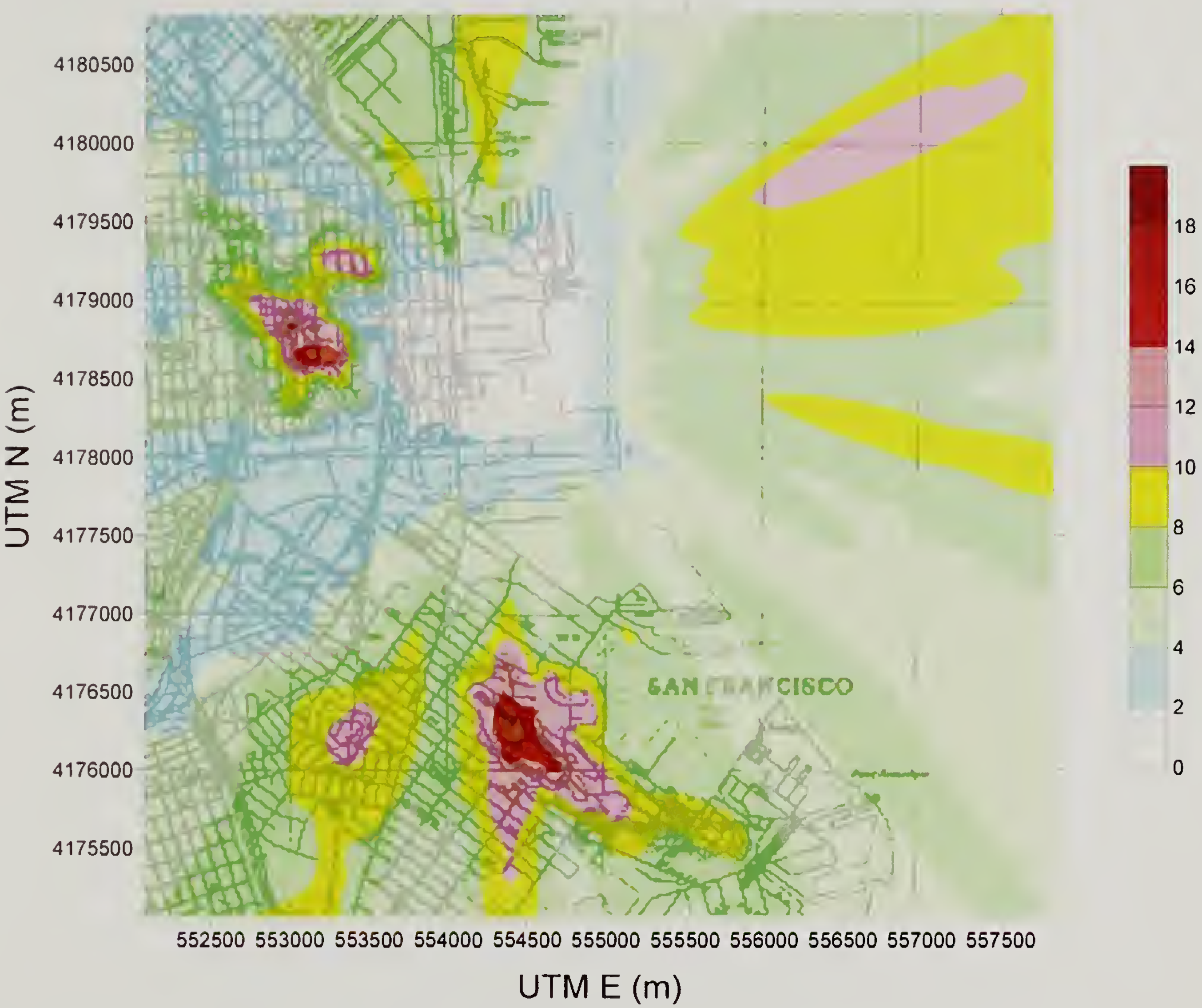
24-hr Average PM_{10} Concentrations, $\mu g/m^3$
SFERP



This figure shows the maximum modeled 24-hour average PM_{10} concentrations from the SFERP project in its current proposed location, with all units operating at full load for 24 hours. The concentrations in the colored areas correspond to the color scale on the right. The highest modeled concentration is less than 2 $\mu g/m^3$.

Figure 8.1B-5b

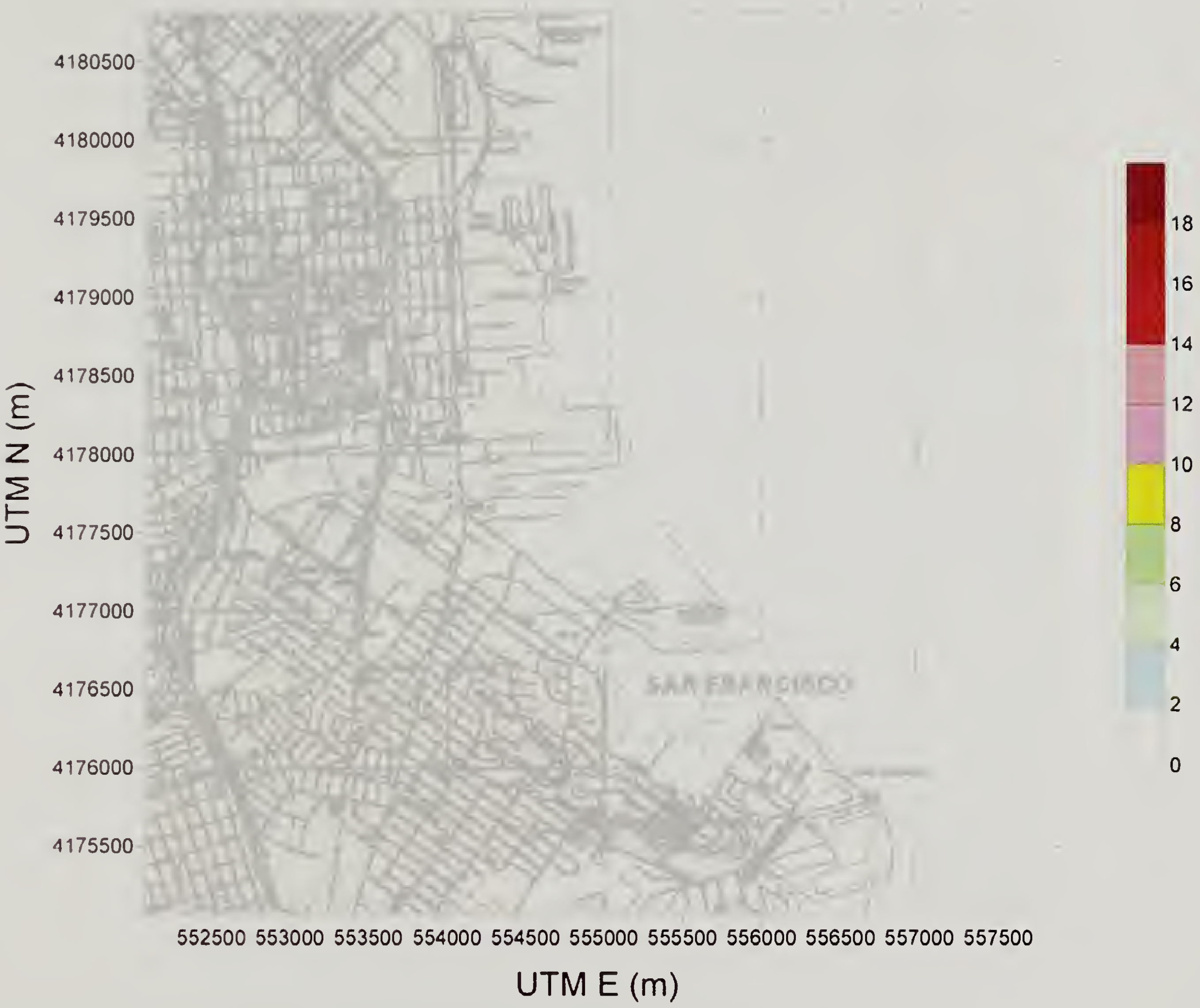
24-hr Average PM_{10} Concentrations, µg/m^3
Potrero and Hunters Point Power Plants



This figure shows the maximum modeled 24-hour average PM_{10} concentrations from the Potrero and Hunters Point Power Plants, with all units operating at full load for 24 hours. The concentrations in the colored areas correspond to the color scale on the right.

Figure 8.1B-5c

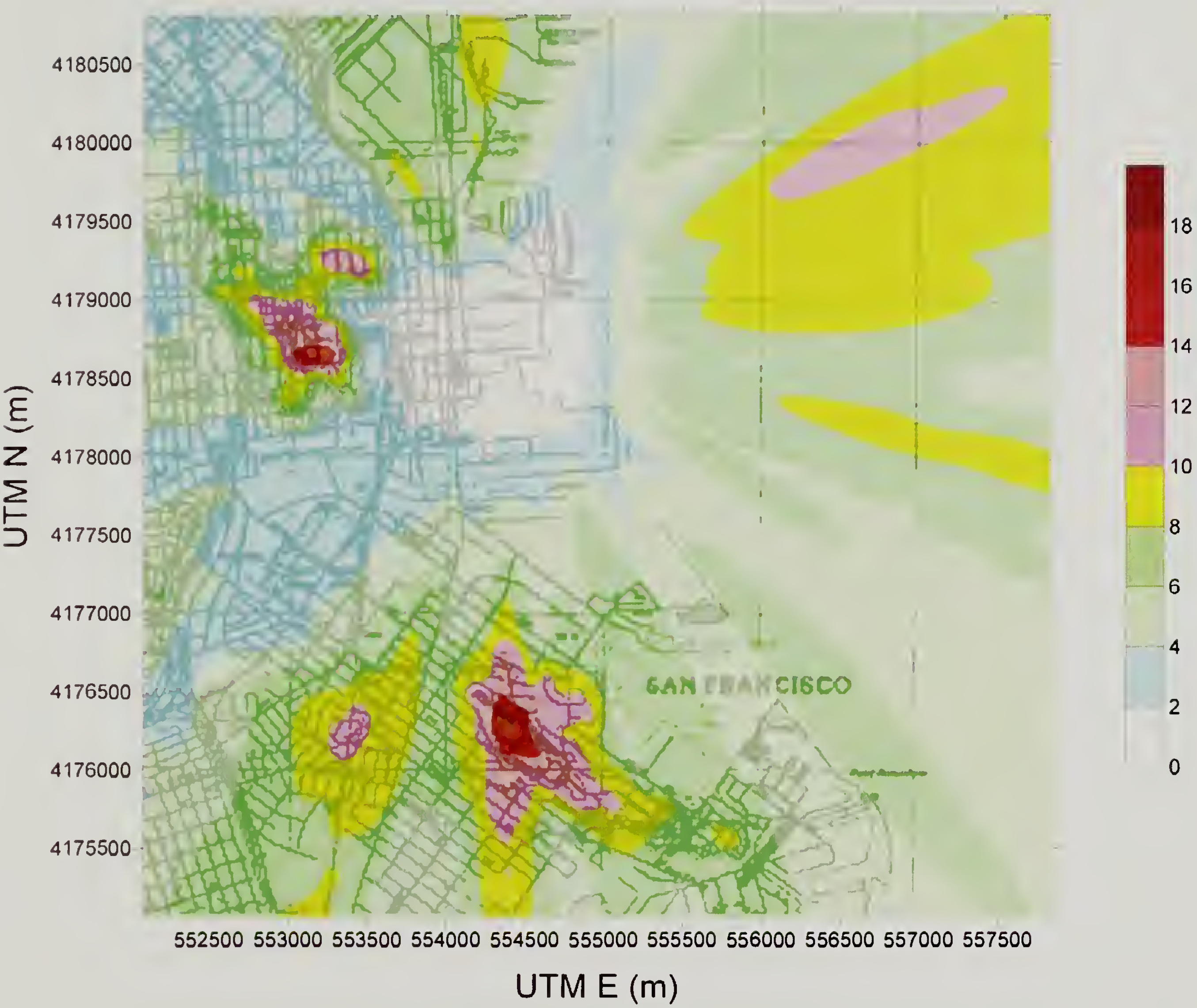
24-hr Average PM_{10} Concentrations, $\mu g/m^3$
Potrero Unit 3



This figure shows the maximum modeled 24-hour average PM_{10} concentrations from the Potrero Power Plant boiler, Unit 3, operating at full load for 24 hours. The concentrations in the colored areas correspond to the color scale on the right. The highest modeled concentration is less than 2 $\mu g/m^3$.

Figure 8.1B-5d

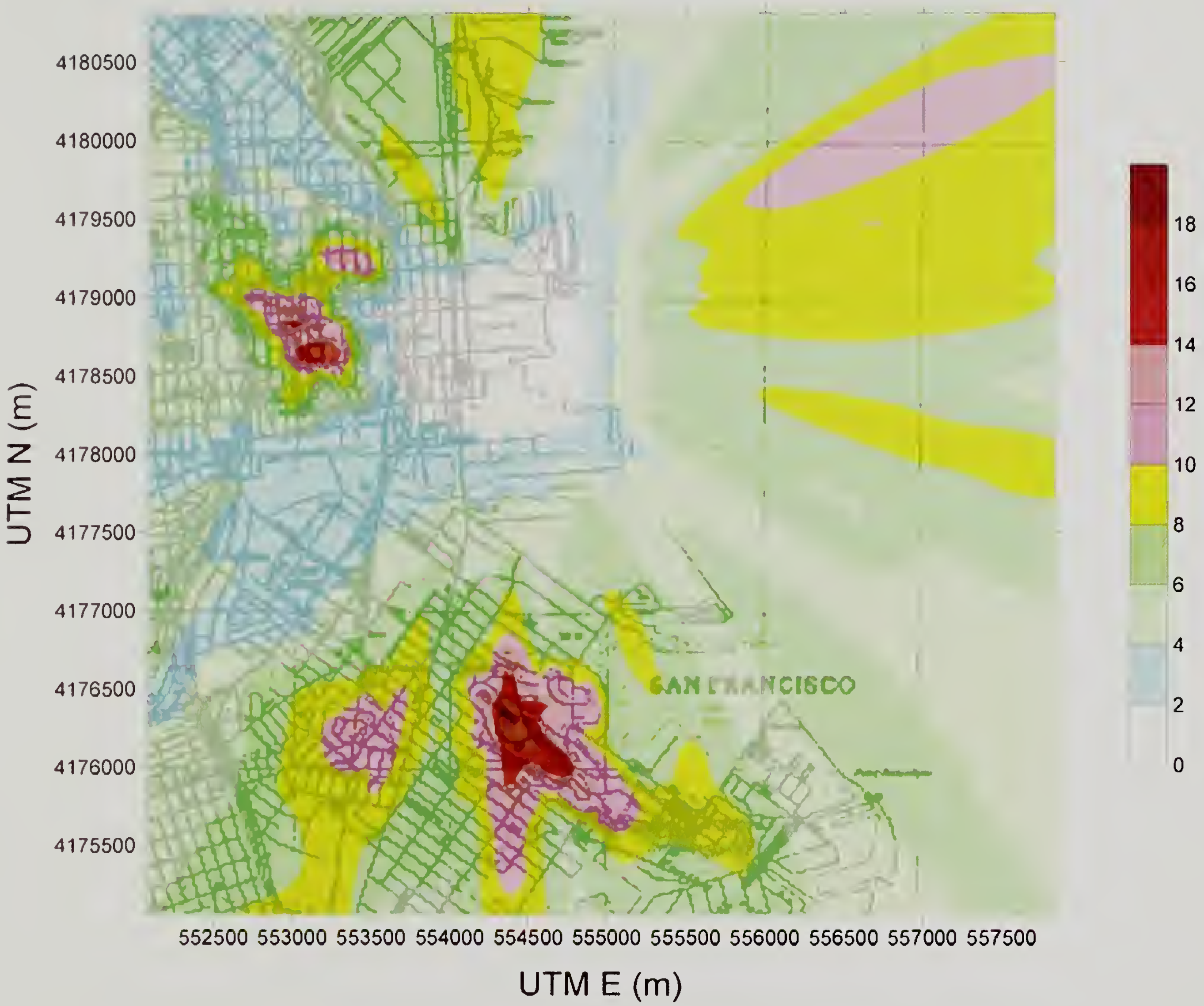
24-hr Average PM_{10} Concentrations, $\mu g/m^3$
Potrero Peaking Turbines



This figure shows the maximum modeled 24-hour average PM_{10} concentrations from the Potrero Power Plant peaking turbines operating at full load for 24 hours. The concentrations in the colored areas correspond to the color scale on the right.

Figure 8.1B-5e

24-hr Average PM_{10} Concentrations, $\mu g/m^3$
Potrero Power Plant and SFERP



This figure shows the maximum modeled 24-hour average PM_{10} concentrations from the Potrero Power Plant and SFERP together, with all units operating at full load for 24 hours. The concentrations in the colored areas correspond to the color scale on the right.

APPENDIX 8.1C

Screening Health Risk Assessment

APPENDIX 8.1C

SCREENING HEALTH RISK ASSESSMENT

8.1C-1 Modeling Methodology

The screening level health risk assessment has been prepared using CARB's Hotspots Analysis and Reporting Program (HARP) computer program and associated guidance in the OEHHA's *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (August 2003). The HARP model was used to assess cancer risk as well as chronic and acute risk impacts. The assessment shows that the cancer risk during operation of the project is below a level of one in one million. During project construction, cancer risk from Diesel construction equipment will range from 0.75 to 1.1 in one million, well below the level of 10 in one million level considered to be significant by CEC and BAAQMD staff. Acute and chronic health impacts are well below the BAAQMD significance level of one. The following paragraphs describe the procedures used to prepare this risk assessment.

8.1C-1.1 Modeling Inputs

The risk assessment module of the HARP model was run using unit ground level impacts to obtain derived cancer risks for each toxic chemical of interest.[1] Cancer risks were obtained for the derived (OEHHA) method, the derived (adjusted) method, average point estimate and high-end point estimate options. The HARP model output was cancer risk by pollutant and route for each type of analysis, based on an exposure of 1.0 $\mu g/m^3$. The emission rates of the toxic air contaminants (see Table 8.1-20) and the results of the turbine screening analysis (see Appendix 8.1B, Table 8.1B-3) were then combined with the HARP unit values to determine final actual cancer risk and hazard indices. HARP model output showing the unit values is included as Attachment HRA-1. Individual cancer risks are expressed in units of risk per $\mu g/m^3$ of exposure. To calculate the weighted risk for each source, the annual average emission rate in g/s for each pollutant was multiplied by the individual cancer risk for that pollutant in $(\mu g/m^3)^{-1}$. The resulting weighted cancer risks for each pollutant were then summed for the source. An identical approach was used to determine the acute and chronic health impacts associated with the proposed project.

Details of the calculations of risk "rates" for modeling are shown in Attachment HRA-2.

8.1C-1.2 Risk Analysis Method

The total weighted risk "rate" for each source was used in place of emission rates with the modeled unit impacts from the turbine screening analysis. The calculated value was then total cancer risk at each receptor. As discussed in Section 8.1.5.3.1, the turbine screening modeling analysis for the criteria pollutant modeling analysis was performed using the ISCST3 model, the 1992 Potrero meteorological data, specific receptor grids, and the stack parameters for six turbine operating cases. The highest full-load annual average unit impact from the screening analysis for was used to characterize cancer risks for the proposed project. A sample calculation for cancer risk follows:

---

[1] Procedure is described in Part B of Topic 8 of the HARP How-To Guides: How to Perform Health Analyses Using a Ground Level Concentration.

Maximum unit impact, full load operation:

Case 1: 0.257 μg/m^3 per 3.0 g/s

Derived (OEHHA) Method Cancer Risk (each turbine):

1.76×10^{-1} in one million per μg/m^3

Derived (OEHHA) Method Cancer Risk:

0.257 μg/m^3 per 3.0 g/s * 1.76×10^{-1} per (μg/m^3 per g/s)

= 4.52×10^{-2} in one million

The chronic health hazard index is calculated in the same manner using the same annual average modeled unit impact and the total weighted chronic HHI input value of 7.13×10^{-3}. The acute health hazard index is calculated using the maximum annual full load one-hour average unit impact of 14.999 μg/m^3 per 3.0 g/s and the total weighted acute HHI input value of 1.67×10^{-3} per μg/m^3.

The contribution of each toxic compound to total cancer risk and total HHI for each analysis method was then determined using the individual contribution of each compound to the total weighted risk "rate."

8.1C-2 Summary of Results

The results of the screening level health risk assessment are summarized in the following table.

Table 8.1C-1

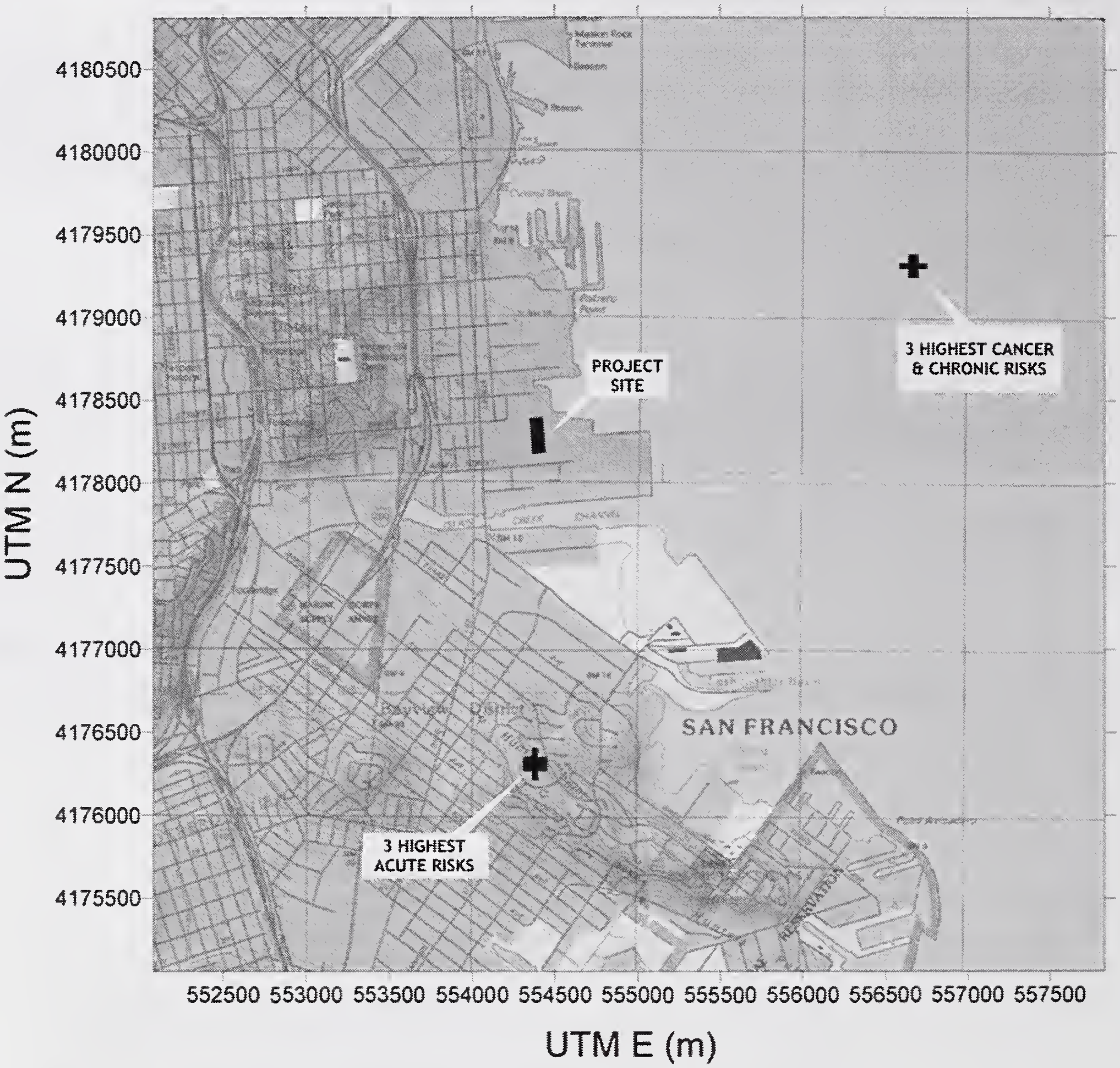
Screening Level Risk Assessment Results

Risk Methodology	Gas Turbines
Modeled Residential Cancer Risk (in one million)	
Residential: Derived (OEHHA) Method	0.045
Residential: Average Point Estimate	0.022
Residential: High-end Point Estimate	0.046
Residential: Derived (adjusted) Method	0.040
Modeled Worker Cancer Risk (in one million)	
Worker Exposure: Derived (OEHHA) Method	0.011
Modeled Acute and Chronic Impacts	
Acute HHI	0.025
Chronic HHI	0.002

As shown in Table 8.1C-1, the cancer risk during project operation will be well below one in one million. During construction, the cancer risk from Diesel equipment operation will range from 0.75 to 1.1 in one million, well below the level of 10 in one million considered significant by the CEC and BAAQMD staffs. In addition, the acute and chronic health impacts are well below the BAAQMD significance level of one. Consequently, there are no significant toxic air contaminant impacts issues associated with the proposed project.

The locations of the three maximum cancer, acute and chronic risks are shown in Figure 8.1C-1. Although toxic substance impacts are below the levels considered to be significant by regulatory agencies, the highest acute hazard from the project will be in Bayview/Hunters Point. To address this concern, the City will target the mitigation to the areas affected by the impacts of the project.

Figure 8.1C-1
Locations of Top Three Acute, Chronic and Cancer Risks from Project Operation



The figures in this chart relate to impacts from operation of the project.

The acute health hazard index for the project is 0.025, meaning that the highest concentration of toxic air contaminants in the air from the project is **40 times lower** than the level that would cause any acute (short-term, immediate) health effects. Although the impacts of toxic air contaminants from the project are below the levels considered to be significant by regulatory agencies, the City recognizes that the highest acute health hazard from the project will be in Bayview/Hunters Point. To address community concerns, the City is developing, with community input, a PM_{10} mitigation/community benefits package. The City will target the mitigation to the areas affected by the impacts from the project.

The chronic health hazard index for the project is 0.002, meaning that the highest concentration of toxic air contaminants in the air from the project is **500 times lower** than the level that would cause any chronic (long-term) health effects.

The highest cancer risk for the project is 0.045 in one million, which is **over 200 times lower** than the ten in one million risk that the regulatory agencies consider to be significant.

The + signs show the locations of the highest acute and chronic health hazard indexes and the highest cancer risk for the project. The health hazard index (HHI) is a ratio of the highest concentration of a toxic air contaminant to the Reference Exposure Level. The Reference Exposure Level (REL) is a concentration in air at or below which no adverse health effects are anticipated. When the HHI is less than one, the concentrations of the toxic air contaminants are so low that no adverse health effects are expected.

Attachment 8.1C-1

HARP Model Risk Assessment Module Output

```
This file: C:\HARP\projects\demo\PointEstimateRisk.txt

Created by HARP Risk Module Version: 21.7.30
Creation date: 6/21/2004 12:20:51 PM


EXCEPTION REPORT
   (there have been no changes or exceptions)

Point Estimate
GLC source: values edited by user
Exposure Duration: 70 year (adult resident)
Analysis Method: Derived (OEHHA) Method

CHEMICAL CROSS-REFERENCE TABLE
CHEM  CAS        ABBREVIATION     POLLUTANT NAME
0001  75070      Acetaldehyde     Acetaldehyde
0002  107028     Acrolein         Acrolein
0003  7664417    Ammonia          Ammonia
0004  71432      Benzene          Benzene
0005  106990     1,3-Butadiene    1,3-Butadiene
0006  9901       DieselExhPM      Diesel engine exhaust, particulate matter
0007  50000      Formaldehyde     Formaldehyde
0008  110543     Hexane           Hexane
0009  56553      B[a]anthracene   Benz[a]anthracene
0010  50328      B[a]P            Benzo[a]pyrene
0011  205992     B[b]fluoranthen  Benzo[b]fluoranthene
0012  207089     B[k]fluoranthen  Benzo[k]fluoranthene
0013  218019     Chrysene         Chrysene
0014  193395     In[1,2,3-cd]pyr  Indeno[1,2,3-cd]pyrene
0015  91203      Naphthalene      Naphthalene
0016  115071     Propylene        Propylene
0017  75569      Propylene Oxide  Propylene oxide
0018  108883     Toluene          Toluene
0019  1210       Xylenes          Xylenes (mixed)
0020  100414     Ethyl Benzene    Ethyl benzene
0021  120127     Anthracene       Anthracene
0022  53703      D[a,h]anthracen  Dibenz[a,h]anthracene

CHEMICAL GROUND LEVEL CONCENTRATIONS (micrograms/m^3)
CHEM  CAS        ABBREVIATION       AVERAGE     HOURLY MAX  WATER       PASTURE     FISH
0001  75070      Acetaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0002  107028     Acrolein           1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0003  7664417    Ammonia            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0004  71432      Benzene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0005  106990     1,3-Butadiene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0006  9901       DieselExhPM        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0007  50000      Formaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0008  110543     Hexane             1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0009  56553      B[a]anthracene     1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0010  50328      B[a]P              1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0011  205992     B[b]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0012  207089     B[k]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0013  218019     Chrysene           1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0014  193395     In[1,2,3-cd]pyr    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0015  91203      Naphthalene        1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0016  115071     Propylene          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0017  75569      Propylene Oxide    1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0018  108883     Toluene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0019  1210       Xylenes            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0020  100414     Ethyl Benzene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0021  120127     Anthracene         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0022  53703      D[a,h]anthracen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00


DOMINANT PATHWAYS FOR CANCER
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CHEM    INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG
0001      YES        -        -        -        -        -        -        -        -        -        -        -
0002        -        -        -        -        -        -        -        -        -        -        -        -
0003        -        -        -        -        -        -        -        -        -        -        -        -
0004      YES        -        -        -        -        -        -        -        -        -        -        -
0005      YES        -        -        -        -        -        -        -        -        -        -        -
0006      YES        -        -        -        -        -        -        -        -        -        -        -
0007      YES        -        -        -        -        -        -        -        -        -        -        -
0008        -        -        -        -        -        -        -        -        -        -        -        -
0009        -      YES      YES        -        -        -        -        -        -        -        -        -
0010        -      YES      YES        -        -        -        -        -        -        -        -        -
0011        -      YES      YES        -        -        -        -        -        -        -        -        -
0012        -      YES      YES        -        -        -        -        -        -        -        -        -
0013        -      YES      YES        -        -        -        -        -        -        -        -        -
0014        -      YES      YES        -        -        -        -        -        -        -        -        -
0015        -        -        -        -        -        -        -        -        -        -        -        -
0016        -        -        -        -        -        -        -        -        -        -        -        -
0017      YES        -        -        -        -        -        -        -        -        -        -        -
0018        -        -        -        -        -        -        -        -        -        -        -        -
0019        -        -        -        -        -        -        -        -        -        -        -        -
0020        -        -        -        -        -        -        -        -        -        -        -        -
0021        -        -        -        -        -        -        -        -        -        -        -        -
0022      YES      YES        -        -        -        -        -        -        -        -        -        -

DERIVED DOSE BY PATHWAY (mg/(kg-d)) FOR CANCER CALCULATIONS
CHEM    INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG    TOTAL
0001 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-04
0002 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.37E-04
0003 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 8.97E-04
0004 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.27E-03
0005 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.65E-03
0006 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.03E-03
0007 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.40E-03
0008 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.66E-03
0009 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.21E-03
0010 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.77E-03
0011 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.32E-03
0012 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 8.87E-03
0013 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.04E-02
0014 2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.20E-02
0015 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.22E-02
0016 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.25E-02
0017 3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.29E-02
0018 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.31E-02
0019 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.34E-02
0020 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.36E-02
0021 2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.39E-02
0022 3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.56E-02

DERIVED CANCER RISK
CHEM    INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG     MEAT     ORAL    TOTAL
0001 3.77E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-06
0002 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0003 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0004 3.77E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-05
0005 2.26E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.26E-04
0006 4.15E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.15E-04
0007 7.91E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.91E-06
0008 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0009 1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0010 1.01E-03 1.35E-02 2.02E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-02 1.65E-02
0011 1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0012 1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0013 1.01E-05 1.35E-04 2.02E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-04 1.65E-04
0014 1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0015 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
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0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0017  4.90E-0[illegible] [illegible]00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0[illegible]+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.90E-06
0018  0.00E+00 [illegible]00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0[illegible]+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.55E-03 4.60E-03 6.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.29E-03 6.84E-03
SUM   3.67E-03 2.36E-02 3.54E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.71E-02 3.08E-02

DOMINANT PATHWAYS FOR CHRONIC
CHEM     INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG
0001       YES        -        -        -        -        -        -        -        -        -        -        -
0002       YES        -        -        -        -        -        -        -        -        -        -        -
0003       YES        -        -        -        -        -        -        -        -        -        -        -
0004       YES        -        -        -        -        -        -        -        -        -        -        -
0005       YES        -        -        -        -        -        -        -        -        -        -        -
0006       YES        -        -        -        -        -        -        -        -        -        -        -
0007       YES        -        -        -        -        -        -        -        -        -        -        -
0008       YES        -        -        -        -        -        -        -        -        -        -        -
0009       YES      YES      YES        -        -        -        -        -        -        -        -        -
0010       YES      YES      YES        -        -        -        -        -        -        -        -        -
0011       YES      YES      YES        -        -        -        -        -        -        -        -        -
0012       YES      YES      YES        -        -        -        -        -        -        -        -        -
0013       YES      YES      YES        -        -        -        -        -        -        -        -        -
0014       YES      YES      YES        -        -        -        -        -        -        -        -        -
0015       YES        -        -        -        -        -        -        -        -        -        -        -
0016       YES        -        -        -        -        -        -        -        -        -        -        -
0017       YES        -        -        -        -        -        -        -        -        -        -        -
0018       YES        -        -        -        -        -        -        -        -        -        -        -
0019       YES        -        -        -        -        -        -        -        -        -        -        -
0020       YES        -        -        -        -        -        -        -        -        -        -        -
0021       YES        -        -        -        -        -        -        -        -        -        -        -
0022       YES      YES      YES        -        -        -        -        -        -        -        -        -

INHALATION CONCENTRATION (ug/m^3) AND DERIVED DOSE BY PATHWAY (mg/(kg-d)) FOR CHRONIC CALCULATIONS
CHEM     INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG
0001  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0002  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0003  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0004  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0005  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0006  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0007  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0008  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0009  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0010  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0011  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0012  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0013  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0014  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0015  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0016  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0017  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0018  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.00E+00 1.17E-03 1.75E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00

DERIVED CHRONIC HI
CHEM        CV      CNS     BONE    DEVEL     ENDO      EYE     GILV    IMMUN     KIDN    REPRO     RESP     SKIN    BLOOD      MAX
0001  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.11E-01 0.00E+00 0.00E+00 1.11E-01
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E+01 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E+01 0.00E+00 0.00E+00 1.67E+01
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-03 0.00E+00 0.00E+00 5.00E-03
0004  0.00E+00 1.67E-02 0.00E+00 1.67E-02 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E-02 1.67E-02
0005  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-02 0.00E+00 0.00E+00 0.00E+00 5.00E-02
```

```
0006  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.00E-01 0.00E+00 0.00E+00 2.00E-01
0007  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-01 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-01 0.00E+00 0.00E+00 3.33E-01
0008  0.00E+00 1.43E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.43E-04
0009  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0010  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0011  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0012  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0013  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0014  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.11E-01 0.00E+00 0.00E+00 1.11E-01
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-04 0.00E+00 0.00E+00 3.33E-04
0017  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-02 0.00E+00 0.00E+00 3.33E-02
0018  0.00E+00 3.33E-03 0.00E+00 3.33E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-03 0.00E+00 0.00E+00 3.33E-03
0019  0.00E+00 1.43E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.43E-03 0.00E+00 0.00E+00 1.43E-03
0020  0.00E+00 0.00E+00 0.00E+00 5.00E-04 5.00E-04 0.00E+00 5.00E-04 0.00E+00 5.00E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-04
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0022  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
SUM   0.00E+00 2.16E-02 0.00E+00 2.05E-02 5.00E-04 1.70E+01 5.00E-04 0.00E+00 5.00E-04 5.00E-02 1.75E+01 0.00E+00 1.67E-02 1.75E+01

ACUTE HI
CHEM        CV      CNS     BONE    DEVEL     ENDO      EYE     GILV    IMMUN     KIDN    REPRO     RESP     SKIN    BLOOD      MAX
0001  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.26E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.26E+00 0.00E+00 0.00E+00 5.26E+00
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.13E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.13E-04 0.00E+00 0.00E+00 3.13E-04
0004  0.00E+00 0.00E+00 0.00E+00 7.69E-04 0.00E+00 0.00E+00 0.00E+00 7.69E-04 0.00E+00 7.69E-04 0.00E+00 0.00E+00 7.69E-04 7.69E-04
0005  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0006  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0007  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.06E-02 0.00E+00 1.06E-02 0.00E+00 0.00E+00 1.06E-02 0.00E+00 0.00E+00 1.06E-02
0008  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0009  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0010  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0011  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0012  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0013  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0014  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0017  0.00E+00 0.00E+00 0.00E+00 3.23E-04 0.00E+00 3.23E-04 0.00E+00 0.00E+00 0.00E+00 3.23E-04 3.23E-04 0.00E+00 0.00E+00 3.23E-04
0018  0.00E+00 2.70E-05 0.00E+00 2.70E-05 0.00E+00 2.70E-05 0.00E+00 0.00E+00 0.00E+00 2.70E-05 2.70E-05 0.00E+00 0.00E+00 2.70E-05
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.55E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.55E-05 0.00E+00 0.00E+00 4.55E-05
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0022  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
SUM   0.00E+00 2.70E-05 0.00E+00 1.12E-03 0.00E+00 5.27E+00 0.00E+00 1.14E-02 0.00E+00 1.12E-03 5.27E+00 0.00E+00 7.69E-04 5.27E+00


SITE PARAMETERS

DEPOSITION

   Deposition rate (m/s)              0.02

DRINKING WATER

*** Pathway disabled ***

FISH

*** Pathway disabled ***

PASTURE

*** Pathway disabled ***

HOME GROWN PRODUCE
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*** Pathway disabled ***

PIGS, CHICKENS AND EGGS

*** Pathway disabled ***

DERMAL ABSORPTION

*** Pathway enabled ***

SOIL INGESTION

*** Pathway enabled ***

MOTHER'S MILK

*** Pathway enabled ***
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This file: C:\[illegible]RP\projects\demo\PointEstimateRisk.txt

Created by HA[illegible]isk Module Version: 21.7.30
Creation date: 6/25/2004 11:17:45 AM


EXCEPTION REPORT
   (there have been no changes or exceptions)

Point Estimate
GLC source: values edited by user
Exposure Duration: 70 year (adult resident)
Analysis Method: Average Point Estimate

CHEMICAL CROSS-REFERENCE TABLE
CHEM  CAS        ABBREVIATION    POLLUTANT NAME
0001  75070      Acetaldehyde    Acetaldehyde
0002  107028     Acrolein        Acrolein
0003  7664417    Ammonia         Ammonia
0004  71432      Benzene         Benzene
0005  106990     1,3-Butadiene   1,3-Butadiene
0006  9901       DieselExhPM     Diesel engine exhaust, particulate matter
0007  50000      Formaldehyde    Formaldehyde
0008  110543     Hexane          Hexane
0009  56553      B[a]anthracene  Benz[a]anthracene
0010  50328      B[a]P           Benzo[a]pyrene
0011  205992     B[b]fluoranthen Benzo[b]fluoranthene
0012  207089     B[k]fluoranthen Benzo[k]fluoranthene
0013  218019     Chrysene        Chrysene
0014  193395     In[1,2,3-cd]pyr Indeno[1,2,3-cd]pyrene
0015  91203      Naphthalene     Naphthalene
0016  115071     Propylene       Propylene
0017  75569      Propylene Oxide Propylene oxide
0018  108883     Toluene         Toluene
0019  1210       Xylenes         Xylenes (mixed)
0020  100414     Ethyl Benzene   Ethyl benzene
0021  120127     Anthracene      Anthracene
0022  53703      D[a,h]anthracen Dibenz[a,h]anthracene

CHEMICAL GROUND LEVEL CONCENTRATIONS (micrograms/m^3)
CHEM  CAS        ABBREVIATION       AVERAGE     HOURLY MAX  WATER       PASTURE     FISH
0001  75070      Acetaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0002  107028     Acrolein           1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0003  7664417    Ammonia            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0004  71432      Benzene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0005  106990     1,3-Butadiene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0006  9901       DieselExhPM        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0007  50000      Formaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0008  110543     Hexane             1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0009  56553      B[a]anthracene     1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0010  50328      B[a]P              1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0011  205992     B[b]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0012  207089     B[k]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0013  218019     Chrysene           1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0014  193395     In[1,2,3-cd]pyr    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0015  91203      Naphthalene        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0016  115071     Propylene          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0017  75569      Propylene Oxide    1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0018  108883     Toluene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0019  1210       Xylenes            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0020  100414     Ethyl Benzene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0021  120127     Anthracene         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0022  53703      D[a,h]anthracen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00


AVERAGE DOSE BY PATHWAY (mg/(kg-d)) FOR CANCER CALCULATIONS
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CHEM     INHAL     DERM      SOIL     MOTHER     FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG     TOTAL
0001  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.60E-04
0002  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.20E-04
0003  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.80E-04
0004  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.04E-03
0005  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.30E-03
0006  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.56E-03
0007  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.82E-03
0008  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.08E-03
0009  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.57E-03
0010  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.07E-03
0011  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.56E-03
0012  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.06E-03
0013  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.55E-03
0014  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.05E-03
0015  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.31E-03
0016  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.57E-03
0017  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.83E-03
0018  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.08E-03
0019  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.34E-03
0020  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.60E-03
0021  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.86E-03
0022  2.60E-04 6.64E-05 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.36E-03

AVERAGE CANCER RISK
CHEM     INHAL     DERM      SOIL     MOTHER     FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG      MEAT      ORAL     TOTAL
0001  2.60E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.60E-06
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0004  2.60E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.60E-05
0005  1.56E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.56E-04
0006  2.86E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.86E-04
0007  5.46E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.46E-06
0008  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0009  1.01E-04 7.96E-05 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-04 3.83E-04
0010  1.01E-03 7.96E-04 2.02E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-03 3.83E-03
0011  1.01E-04 7.96E-05 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-04 3.83E-04
0012  1.01E-04 7.96E-05 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-04 3.83E-04
0013  1.01E-05 7.96E-06 2.02E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-05 3.83E-05
0014  1.01E-04 7.96E-05 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.81E-04 3.83E-04
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0017  3.38E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.38E-06
0018  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.07E-03 2.72E-04 6.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 9.62E-04 2.03E-03
SUM   2.97E-03 1.39E-03 3.54E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.93E-03 7.90E-03


SITE PARAMETERS

DEPOSITION

   Deposition rate (m/s)              0.02

DRINKING WATER

*** Pathway disabled ***

FISH

*** Pathway disabled ***
```

```
PASTURE

*** Pathway disabled ***

HOME GROWN PRODUCE

*** Pathway disabled ***

PIGS, CHICKENS AND EGGS

*** Pathway disabled ***

DERMAL ABSORPTION

*** Pathway enabled ***

SOIL INGESTION

*** Pathway enabled ***

MOTHER'S MILK

*** Pathway enabled ***
```

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This file: C:\HARP\projects\demo\PointEstimateRisk.txt

Created by HAR[illegible]Risk Module Version: 21.7.30
Creation date: 6/25/2004 11:17:11 AM


EXCEPTION REPORT
   (there have been no changes or exceptions)

Point Estimate
GLC source: values edited by user
Exposure Duration: 70 year (adult resident)
Analysis Method: High-end Point Estimate

CHEMICAL CROSS-REFERENCE TABLE
CHEM  CAS        ABBREVIATION      POLLUTANT NAME
0001  75070      Acetaldehyde      Acetaldehyde
0002  107028     Acrolein          Acrolein
0003  7664417    Ammonia           Ammonia
0004  71432      Benzene           Benzene
0005  106990     1,3-Butadiene     1,3-Butadiene
0006  9901       DieselExhPM       Diesel engine exhaust, particulate matter
0007  50000      Formaldehyde      Formaldehyde
0008  110543     Hexane            Hexane
0009  56553      B[a]anthracene    Benz[a]anthracene
0010  50328      B[a]P             Benzo[a]pyrene
0011  205992     B[b]fluoranthen   Benzo[b]fluoranthene
0012  207089     B[k]fluoranthen   Benzo[k]fluoranthene
0013  218019     Chrysene          Chrysene
0014  193395     In[1,2,3-cd]pyr   Indeno[1,2,3-cd]pyrene
0015  91203      Naphthalene       Naphthalene
0016  115071     Propylene         Propylene
0017  75569      Propylene Oxide   Propylene oxide
0018  108883     Toluene           Toluene
0019  1210       Xylenes           Xylenes (mixed)
0020  100414     Ethyl Benzene     Ethyl benzene
0021  120127     Anthracene        Anthracene
0022  53703      D[a,h]anthracen   Dibenz[a,h]anthracene

CHEMICAL GROUND LEVEL CONCENTRATIONS (micrograms/m^3)
CHEM  CAS        ABBREVIATION         AVERAGE     HOURLY MAX  WATER       PASTURE     FISH
0001  75070      Acetaldehyde         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0002  107028     Acrolein             1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0003  7664417    Ammonia              1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0004  71432      Benzene              1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0005  106990     1,3-Butadiene        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0006  9901       DieselExhPM          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0007  50000      Formaldehyde         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0008  110543     Hexane               1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0009  56553      B[a]anthracene       1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0010  50328      B[a]P                1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0011  205992     B[b]fluoranthen      1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0012  207089     B[k]fluoranthen      1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0013  218019     Chrysene             1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0014  193395     In[1,2,3-cd]pyr      1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0015  91203      Naphthalene          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0016  115071     Propylene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0017  75569      Propylene Oxide      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0018  108883     Toluene              1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0019  1210       Xylenes              1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0020  100414     Ethyl Benzene        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0021  120127     Anthracene           1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0022  53703      D[a,h]anthracen      1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00


HIGH-END DOSE BY PATHWAY (mg/(kg-d)) FOR CANCER CALCULATIONS
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CHEM      INHAL     DERM      SOIL    MOTHER      FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG     TOTAL
0001  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-04
0002  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.54E-04
0003  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.13E-03
0004  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.51E-03
0005  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.88E-03
0006  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.26E-03
0007  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.64E-03
0008  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.01E-03
0009  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.68E-03
0010  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.35E-03
0011  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 8.02E-03
0012  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 9.69E-03
0013  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.14E-02
0014  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.30E-02
0015  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.34E-02
0016  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.38E-02
0017  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.42E-02
0018  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.45E-02
0019  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.49E-02
0020  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.53E-02
0021  3.77E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.57E-02
0022  3.77E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.73E-02

HIGH-END CANCER RISK
CHEM      INHAL     DERM      SOIL    MOTHER      FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG      MEAT      ORAL     TOTAL
0001  3.77E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-06
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0004  3.77E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.77E-05
0005  2.26E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.26E-04
0006  4.15E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.15E-04
0007  7.91E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 7.91E-06
0008  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0009  1.47E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.70E-03
0010  1.47E-03 1.35E-02 2.02E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-02 1.70E-02
0011  1.47E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.70E-03
0012  1.47E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.70E-03
0013  1.47E-05 1.35E-04 2.02E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-04 1.70E-04
0014  1.47E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.70E-03
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0017  4.90E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.90E-06
0018  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.55E-03 4.60E-03 6.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.29E-03 6.84E-03
SUM   4.31E-03 2.36E-02 3.54E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.71E-02 3.15E-02


SITE PARAMETERS

DEPOSITION

   Deposition rate (m/s)             0.02

DRINKING WATER

*** Pathway disabled ***

FISH

*** Pathway disabled ***
```

```
PASTURE

*** Pathway disabled ***

HOME GROWN PRODUCE

*** Pathway disabled ***

PIGS, CHICKENS AND EGGS

*** Pathway disabled ***

DERMAL ABSORPTION

*** Pathway enabled ***

SOIL INGESTION

*** Pathway enabled ***

MOTHER'S MILK

*** Pathway enabled ***
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This file: C:\HARP\projects\demo\PointEstimateRisk.txt

Created by HARP Risk Module Version: 21.7.30
Creation date: 6/25/2004 11:22:44 AM


EXCEPTION REPORT
   (there have been no changes or exceptions)

Point Estimate
GLC source: values edited by user
Exposure Duration: 70 year (adult resident)
Analysis Method: Derived (Adjusted) Method

CHEMICAL CROSS-REFERENCE TABLE
CHEM  CAS        ABBREVIATION     POLLUTANT NAME
0001  75070      Acetaldehyde     Acetaldehyde
0002  107028     Acrolein         Acrolein
0003  7664417    Ammonia          Ammonia
0004  71432      Benzene          Benzene
0005  106990     1,3-Butadiene    1,3-Butadiene
0006  9901       DieselExhPM      Diesel engine exhaust, particulate matter
0007  50000      Formaldehyde     Formaldehyde
0008  110543     Hexane           Hexane
0009  56553      B[a]anthracene   Benz[a]anthracene
0010  50328      B[a]P            Benzo[a]pyrene
0011  205992     B[b]fluoranthen Benzo[b]fluoranthene
0012  207089     B[k]fluoranthen Benzo[k]fluoranthene
0013  218019     Chrysene         Chrysene
0014  193395     In[1,2,3-cd]pyr Indeno[1,2,3-cd]pyrene
0015  91203      Naphthalene      Naphthalene
0016  115071     Propylene        Propylene
0017  75569      Propylene Oxide Propylene oxide
0018  108883     Toluene          Toluene
0019  1210       Xylenes          Xylenes (mixed)
0020  100414     Ethyl Benzene    Ethyl benzene
0021  120127     Anthracene       Anthracene
0022  53703      D[a,h]anthracen Dibenz[a,h]anthracene

CHEMICAL GROUND LEVEL CONCENTRATIONS (micrograms/m^3)
CHEM  CAS        ABBREVIATION       AVERAGE     HOURLY MAX  WATER       PASTURE     FISH
0001  75070      Acetaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0002  107028     Acrolein           1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0003  7664417    Ammonia            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0004  71432      Benzene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0005  106990     1,3-Butadiene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0006  9901       DieselExhPM        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0007  50000      Formaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0008  110543     Hexane             1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0009  56553      B[a]anthracene     1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0010  50328      B[a]P              1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0011  205992     B[b]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0012  207089     B[k]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0013  218019     Chrysene           1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0014  193395     In[1,2,3-cd]pyr    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0015  91203      Naphthalene        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0016  115071     Propylene          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0017  75569      Propylene Oxide    1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0018  108883     Toluene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0019  1210       Xylenes            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0020  100414     Ethyl Benzene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0021  120127     Anthracene         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0022  53703      D[a,h]anthracen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00


DOMINANT PATHWAYS FOR CANCER
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CHEM     INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG
0001         A        -        -        -        -        -        -        -        -        -        -        -
0002         -        -        -        -        -        -        -        -        -        -        -        -
0003         -        -        -        -        -        -        -        -        -        -        -        -
0004         A        -        -        -        -        -        -        -        -        -        -        -
0005         A        -        -        -        -        -        -        -        -        -        -        -
0006         A        -        -        -        -        -        -        -        -        -        -        -
0007         A        -        -        -        -        -        -        -        -        -        -        -
0008         -        -        -        -        -        -        -        -        -        -        -        -
0009         -      YES      YES        -        -        -        -        -        -        -        -        -
0010         -      YES      YES        -        -        -        -        -        -        -        -        -
0011         -      YES      YES        -        -        -        -        -        -        -        -        -
0012         -      YES      YES        -        -        -        -        -        -        -        -        -
0013         -      YES      YES        -        -        -        -        -        -        -        -        -
0014         -      YES      YES        -        -        -        -        -        -        -        -        -
0015         -        -        -        -        -        -        -        -        -        -        -        -
0016         -        -        -        -        -        -        -        -        -        -        -        -
0017         A        -        -        -        -        -        -        -        -        -        -        -
0018         -        -        -        -        -        -        -        -        -        -        -        -
0019         -        -        -        -        -        -        -        -        -        -        -        -
0020         -        -        -        -        -        -        -        -        -        -        -        -
0021         -        -        -        -        -        -        -        -        -        -        -        -
0022         A      YES        -        -        -        -        -        -        -        -        -        -

DERIVED DOSE BY PATHWAY (mg/(kg-d)) FOR CANCER CALCULATIONS
CHEM     INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG    TOTAL
0001  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.90E-04
0002  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.49E-04
0003  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 8.09E-04
0004  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.10E-03
0005  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.39E-03
0006  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.68E-03
0007  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.97E-03
0008  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.23E-03
0009  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.78E-03
0010  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.33E-03
0011  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.88E-03
0012  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 8.43E-03
0013  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 9.98E-03
0014  2.60E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.15E-02
0015  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.18E-02
0016  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.21E-02
0017  2.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.23E-02
0018  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.26E-02
0019  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.29E-02
0020  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.31E-02
0021  2.60E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.34E-02
0022  2.90E-04 1.12E-03 1.68E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.50E-02

DERIVED CANCER RISK
CHEM     INHAL     DERM     SOIL   MOTHER     FISH    WATER      VEG    DAIRY     BEEF    CHICK      PIG      EGG     MEAT     ORAL    TOTAL
0001  2.90E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.90E-06
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0004  2.90E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.90E-05
0005  1.74E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.74E-04
0006  3.19E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.19E-04
0007  6.08E-06 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.08E-06
0008  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0009  1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0010  1.01E-03 1.35E-02 2.02E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-02 1.65E-02
0011  1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0012  1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0013  1.01E-05 1.35E-04 2.02E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-04 1.65E-04
0014  1.01E-04 1.35E-03 2.02E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.55E-03 1.65E-03
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
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0016  0.00E+0[illegible].00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0[illegible]E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0017  3.76E-[illegible]00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 [illegible]E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.76E-06
0018  0.00E+0[illegible].00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 [illegible]E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.19E-03 4.60E-03 6.90E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.29E-03 6.48E-03
SUM   3.15E-03 2.36E-02 3.54E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.71E-02 3.03E-02


SITE PARAMETERS

DEPOSITION

   Deposition rate (m/s)              0.02

DRINKING WATER

*** Pathway disabled ***

FISH

*** Pathway disabled ***

PASTURE

*** Pathway disabled ***

HOME GROWN PRODUCE

*** Pathway disabled ***

PIGS, CHICKENS AND EGGS

*** Pathway disabled ***

DERMAL ABSORPTION

*** Pathway enabled ***

SOIL INGESTION

*** Pathway enabled ***

MOTHER'S MILK

*** Pathway enabled ***
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This file: C:\[illegible]RP\projects\demo\PointEstimateRisk.txt

Created by HA[illegible]Risk Module Version: 21.7.30
Creation date: 6/21/2004 12:21:13 PM


EXCEPTION REPORT
   (there have been no changes or exceptions)

Point Estimate
GLC source: values edited by user
Exposure Duration: Standard work schedule (49 wks/yr, 5 days/wk, 8 hrs/day, 40 yrs)
Analysis Method: Point estimate

CHEMICAL CROSS-REFERENCE TABLE
CHEM  CAS       ABBREVIATION    POLLUTANT NAME
0001  75070     Acetaldehyde    Acetaldehyde
0002  107028    Acrolein        Acrolein
0003  7664417   Ammonia         Ammonia
0004  71432     Benzene         Benzene
0005  106990    1,3-Butadiene   1,3-Butadiene
0006  9901      DieselExhPM     Diesel engine exhaust, particulate matter
0007  50000     Formaldehyde    Formaldehyde
0008  110543    Hexane          Hexane
0009  56553     B[a]anthracene  Benz[a]anthracene
0010  50328     B[a]P           Benzo[a]pyrene
0011  205992    B[b]fluoranthen Benzo[b]fluoranthene
0012  207089    B[k]fluoranthen Benzo[k]fluoranthene
0013  218019    Chrysene        Chrysene
0014  193395    In[1,2,3-cd]pyr Indeno[1,2,3-cd]pyrene
0015  91203     Naphthalene     Naphthalene
0016  115071    Propylene       Propylene
0017  75569     Propylene Oxide Propylene oxide
0018  108883    Toluene         Toluene
0019  1210      Xylenes         Xylenes (mixed)
0020  100414    Ethyl Benzene   Ethyl benzene
0021  120127    Anthracene      Anthracene
0022  53703     D[a,h]anthracen Dibenz[a,h]anthracene

CHEMICAL GROUND LEVEL CONCENTRATIONS (micrograms/m^3)
CHEM  CAS       ABBREVIATION       AVERAGE     HOURLY MAX  WATER       PASTURE     FISH
0001  75070     Acetaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0002  107028    Acrolein           1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0003  7664417   Ammonia            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0004  71432     Benzene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0005  106990    1,3-Butadiene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0006  9901      DieselExhPM        1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0007  50000     Formaldehyde       1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0008  110543    Hexane             1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0009  56553     B[a]anthracene     1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0010  50328     B[a]P              1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0011  205992    B[b]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0012  207089    B[k]fluoranthen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0013  218019    Chrysene           1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0014  193395    In[1,2,3-cd]pyr    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0015  91203     Naphthalene        1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00
0016  115071    Propylene          1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0017  75569     Propylene Oxide    1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0018  108883    Toluene            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0019  1210      Xylenes            1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0020  100414    Ethyl Benzene      1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0021  120127    Anthracene         1.000E+00   1.000E+00   0.000E+00   0.000E+00   0.000E+00
0022  53703     D[a,h]anthracen    1.000E+00   1.000E+00   1.000E+00   1.000E+00   1.000E+00


AVERAGE DOSE BY PATHWAY (mg/(kg-d)) FOR CANCER CALCULATIONS
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CHEM     INHAL      DERM      SOIL    MOTHER      FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG     TOTAL
0001  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.72E-05
0002  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.14E-04
0003  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.71E-04
0004  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  2.29E-04
0005  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  2.86E-04
0006  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.43E-04
0007  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  4.00E-04
0008  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  4.57E-04
0009  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  9.96E-04
0010  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.54E-03
0011  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  2.07E-03
0012  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  2.61E-03
0013  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.15E-03
0014  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.69E-03
0015  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.75E-03
0016  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.80E-03
0017  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.86E-03
0018  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.92E-03
0019  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.98E-03
0020  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  4.03E-03
0021  5.72E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  4.09E-03
0022  5.72E-05  4.26E-04  5.54E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  4.63E-03

AVERAGE CANCER RISK
CHEM     INHAL      DERM      SOIL    MOTHER      FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG      MEAT      ORAL     TOTAL
0001  5.72E-07  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.72E-07
0002  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0003  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0004  5.72E-06  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.72E-06
0005  3.43E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  3.43E-05
0006  6.29E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  6.29E-05
0007  1.20E-06  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.20E-06
0008  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0009  2.23E-05  5.12E-04  6.65E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-04  6.00E-04
0010  2.23E-04  5.12E-03  6.65E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-03  6.00E-03
0011  2.23E-05  5.12E-04  6.65E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-04  6.00E-04
0012  2.23E-05  5.12E-04  6.65E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-04  6.00E-04
0013  2.23E-06  5.12E-05  6.65E-06  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-05  6.00E-05
0014  2.23E-05  5.12E-04  6.65E-05  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  5.78E-04  6.00E-04
0015  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0016  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0017  7.43E-07  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  7.43E-07
0018  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0019  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0020  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0021  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0022  2.34E-04  1.75E-03  2.27E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.98E-03  2.21E-03
SUM   6.54E-04  8.96E-03  1.16E-03  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  1.01E-02  1.08E-02

INHALATION CONCENTRATION (ug/m^3) AND AVERAGE DOSE BY PATHWAY (mg/(kg-d)) FOR CHRONIC CALCULATIONS
CHEM     INHAL      DERM      SOIL    MOTHER      FISH     WATER       VEG     DAIRY      BEEF     CHICK       PIG       EGG
0001  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0002  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0003  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0004  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0005  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0006  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0007  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0008  1.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0009  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0010  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0011  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0012  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0013  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
0014  1.00E+00  1.11E-03  1.44E-04  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00  0.00E+00
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0015  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0016  1.00E+0[illegible]00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0[illegible]+00 0.00E+00 0.00E+00 0.00E+00
0017  1.00E+0[illegible].00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0[illegible]E+00 0.00E+00 0.00E+00 0.00E+00
0018  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0019  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0020  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0021  1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00
0022  1.00E+00 1.11E-03 1.44E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00

AVERAGE CHRONIC HI
CHEM        CV      CNS     BONE    DEVEL     ENDO      EYE     GILV    IMMUN     KIDN    REPRO     RESP     SKIN    BLOOD      MAX
0001  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.11E-01 0.00E+00 0.00E+00 1.11E-01
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E+01 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E+01 0.00E+00 0.00E+00 1.67E+01
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-03 0.00E+00 0.00E+00 5.00E-03
0004  0.00E+00 1.67E-02 0.00E+00 1.67E-02 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.67E-02 1.67E-02
0005  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-02 0.00E+00 0.00E+00 0.00E+00 5.00E-02
0006  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.00E-01 0.00E+00 0.00E+00 2.00E-01
0007  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-01 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-01 0.00E+00 0.00E+00 3.33E-01
0008  0.00E+00 1.43E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.43E-04
0009  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0010  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0011  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0012  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0013  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0014  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.11E-01 0.00E+00 0.00E+00 1.11E-01
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-04 0.00E+00 0.00E+00 3.33E-04
0017  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-02 0.00E+00 0.00E+00 3.33E-02
0018  0.00E+00 3.33E-03 0.00E+00 3.33E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.33E-03 0.00E+00 0.00E+00 3.33E-03
0019  0.00E+00 1.43E-03 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.43E-03 0.00E+00 0.00E+00 1.43E-03
0020  0.00E+00 0.00E+00 0.00E+00 5.00E-04 5.00E-04 0.00E+00 5.00E-04 0.00E+00 5.00E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E-04
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0022  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
SUM   0.00E+00 2.16E-02 0.00E+00 2.05E-02 5.00E-04 1.70E+01 5.00E-04 0.00E+00 5.00E-04 5.00E-02 1.75E+01 0.00E+00 1.67E-02 1.75E+01

ACUTE HI
CHEM        CV      CNS     BONE    DEVEL     ENDO      EYE     GILV    IMMUN     KIDN    REPRO     RESP     SKIN    BLOOD      MAX
0001  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0002  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.26E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.26E+00 0.00E+00 0.00E+00 5.26E+00
0003  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.13E-04 0.00E+00 0.00E+00 0.00E+00 0.00E+00 3.13E-04 0.00E+00 0.00E+00 3.13E-04
0004  0.00E+00 0.00E+00 0.00E+00 7.69E-04 0.00E+00 0.00E+00 0.00E+00 7.69E-04 0.00E+00 7.69E-04 0.00E+00 0.00E+00 7.69E-04 7.69E-04
0005  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0006  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0007  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.06E-02 0.00E+00 1.06E-02 0.00E+00 0.00E+00 1.06E-02 0.00E+00 0.00E+00 1.06E-02
0008  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0009  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0010  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0011  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0012  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0013  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0014  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0015  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0016  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0017  0.00E+00 0.00E+00 0.00E+00 3.23E-04 0.00E+00 3.23E-04 0.00E+00 0.00E+00 0.00E+00 3.23E-04 3.23E-04 0.00E+00 0.00E+00 3.23E-04
0018  0.00E+00 2.70E-05 0.00E+00 2.70E-05 0.00E+00 2.70E-05 0.00E+00 0.00E+00 0.00E+00 2.70E-05 2.70E-05 0.00E+00 0.00E+00 2.70E-05
0019  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.55E-05 0.00E+00 0.00E+00 0.00E+00 0.00E+00 4.55E-05 0.00E+00 0.00E+00 4.55E-05
0020  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0021  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
0022  0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-30
SUM   0.00E+00 2.70E-05 0.00E+00 1.12E-03 0.00E+00 5.27E+00 0.00E+00 1.14E-02 0.00E+00 1.12E-03 5.27E+00 0.00E+00 7.69E-04 5.27E+00


SITE PARAMETERS

DEPOSITION
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```
   Deposition rate (m/s)            0.02

DRINKING WATER

*** Pathway disabled ***

FISH

*** Pathway disabled ***

PASTURE

*** Pathway disabled ***

HOME GROWN PRODUCE

*** Pathway disabled ***

PIGS, CHICKENS AND EGGS

*** Pathway disabled ***

DERMAL ABSORPTION

*** Pathway enabled ***

SOIL INGESTION

*** Pathway enabled ***

MOTHER'S MILK

*** Pathway enabled ***
```

Attachment 8.1C-2

Calculation of Weighted Risk Rates for Modeling

Table 8.1C-2
San Francisco Electric Reliability Project
Calculation of Cancer Risk Assessment Modeling Inputs for Combustion Turbines

		Residential (70-yr) Exposure			Residential (70-yr) Exposure			Residential (70-yr) Exposure			Residential (70-yr) Exposure			Worker Exposure		
Compound	Annual Average Emissions Per Turbine, g/s	Derived (OEHHA) Method Unit Risk (per ug/m3)	Derived (OEHHA) Method Cancer Risk Model Input (each turbine, per ug/m3 per g/s)	Modeled Contribution to Cancer Risk (2)	Average Point Est Unit Risk (per ug/m3)	Average Point Est Cancer Risk Model Input (each turbine, per ug/m3 per g/s)	Modeled Contribution to Cancer Risk (3)	High-End Point Est Unit Risk (per ug/m3)	High-End Point Est Cancer Risk Model Input (each turbine, per ug/m3 per g/s)	Modeled Contribution to Cancer Risk (4)	Derived (Adjusted) Method Unit Risk (per ug/m3)	Derived (Adjusted) Method Cancer Risk Model Input (each turbine, per ug/m3 per g/s)	Modeled Contribution to Cancer Risk (5)	Derived (OEHHA) Method Unit Risk (per ug/m3)	Derived (OEHHA) Method Cancer Risk Model Input (each turbine, per ug/m3 per g/s)	Modeled Contribution to Cancer Risk (6)
Ammonia	3.76E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Propylene	2.13E-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetaldehyde	1.12E-03	3.77E-06	4.24E-03	1.09E-03	2.60E-06	2.92E-03	7.52E-04	3.77E-06	4.24E-03	1.09E-03	2.90E-06	3.26E-03	8.38E-04	5.72E-07	6.43E-04	1.65E-04
Acrolein	1.02E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	9.18E-05	3.77E-05	3.46E-03	8.89E-04	2.60E-05	2.39E-03	6.13E-04	3.77E-05	3.46E-03	8.89E-04	2.90E-05	2.66E-03	6.84E-04	5.72E-06	5.25E-04	1.35E-04
1,3-Butadiene	1.21E-05	2.26E-04	2.74E-03	7.03E-04	1.56E-04	1.89E-03	4.85E-04	2.26E-04	2.74E-03	7.03E-04	1.74E-04	2.11E-03	5.41E-04	3.43E-05	4.15E-04	1.07E-04
Ethylbenzene	8.99E-04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Formaldehyde	1.01E-02	7.91E-06	8.00E-02	2.06E-02	5.46E-06	5.52E-02	1.42E-02	7.91E-06	8.00E-02	2.06E-02	6.08E-06	6.15E-02	1.58E-02	1.20E-06	1.21E-02	3.12E-03
Hexane	7.14E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Naphthalene	4.58E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PAHs (listed individually below) (Note 1)	4.93E-06	1.65E-02	8.14E-02	2.09E-02	3.83E-03	1.89E-02	4.86E-03	1.70E-02	8.39E-02	2.16E-02	1.65E-02	8.14E-02	2.09E-02	6.00E-03	2.96E-02	7.61E-03
Benzo(a)anthracene		*1.65E-03*			*3.83E-04*			*1.70E-03*			*1.65E-02*			*6.00E-04*		
Benzo(a)pyrene		*1.65E-02*			*3.83E-03*			*1.70E-02*			*1.65E-03*			*6.00E-03*		
Benzo(b)fluoranthrene		*1.65E-03*			*3.83E-04*			*1.70E-03*			*1.65E-03*			*6.00E-04*		
Benzo(k)fluoranthrene		*1.65E-03*			*3.83E-04*			*1.70E-03*			*1.65E-03*			*6.00E-04*		
Chrysene		*1.65E-04*			*3.83E-05*			*1.70E-04*			*1.65E-04*			*6.00E-05*		
Dibenz(a,h)anthracene		*6.84E-03*			*2.03E-03*			*6.84E-03*			*6.48E-03*			*2.21E-03*		
Indeno(1,2,3-cd)pyrene		*1.65E-03*			*3.83E-04*			*1.70E-03*			*1.65E-03*			*6.00E-04*		
Propylene oxide	8.16E-04	4.90E-06	4.00E-03	1.03E-03	3.38E-06	2.76E-03	7.09E-04	4.90E-06	4.00E-03	1.03E-03	3.76E-06	3.07E-03	7.89E-04	7.43E-07	6.06E-04	1.56E-04
Toluene	3.67E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylene	1.80E-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			1.76E-01 in one million per ug/m3 per g/s	4.52E-02 in one million		8.41E-02 in one million per ug/m3 per g/s	2.16E-02 in one million		1.78E-01 in one million per ug/m3 per g/s	4.58E-02 in one million		1.54E-01 in one million per ug/m3 per g/s	3.96E-02 in one million		4.39E-02 in one million per ug/m3 per g/s	1.13E-02 in one million

Notes:

(1) Maximum unit risk value applied to all PAHs for purposes of this analysis.
(2) Based on modeled cancer risk from the turbines of 0.045 in one million.
(3) Based on modeled cancer risk from the turbines of 0.022 in one million.
(4) Based on modeled cancer risk from the turbines of 0.046 in one million.
(5) Based on modeled cancer risk from the turbines of 0.040 in one million.
(6) Based on modeled cancer risk from the turbines of 0.011 in one million.

Table 8.1C-3

San Francisco Electric Reliability Project

Calculation of Risk Assessment Modeling Inputs for Combustion Turbines

Compound	Max Hourly Emissions Per Turbine g/s	HARP Acute HI (per ug/m3 per g/s)	Acute HHI Model Input (per ug/m3)	Modeled Contribution to Acute HHI	Annual Average Emissions, g/s	HARP Chronic HI (per ug/m3 per g/s)	Chronic HHI Model Input (per ug/m3)	Modeled Contribution to Chronic HHI
Ammonia	0.8240	3.13E-04	2.58E-04	3.87E-03	3.76E-01	5.00E-03	1.88E-03	4.84E-04
Propylene	0.0465	--	--	--	2.13E-02	3.33E-04	7.08E-06	1.82E-06
Acetaldehyde	2.463E-03	--	--	--	1.12E-03	1.11E-01	1.25E-04	3.21E-05
Acrolein	2.228E-04	5.26E+00	1.17E-03	1.76E-02	1.02E-04	1.67E+01	1.70E-03	4.37E-04
Benzene	2.010E-04	7.69E-04	1.55E-07	2.32E-06	9.18E-05	1.67E-02	1.53E-06	3.94E-07
1,3-Butadiene	2.650E-05	--	--	--	1.21E-05	5.00E-02	6.05E-07	1.56E-07
Ethylbenzene	1.968E-03	--	--	--	8.99E-04	5.00E-04	4.49E-07	1.15E-07
Formaldehyde	2.216E-02	1.06E-02	2.35E-04	3.52E-03	1.01E-02	3.33E-01	3.37E-03	8.66E-04
Hexane	1.564E-02	--	--	--	7.14E-03	1.43E-04	1.02E-06	2.62E-07
Naphthalene	1.002E-04	--	--	--	4.58E-05	1.11E-01	5.08E-06	1.31E-06
PAHs (listed individually below)	1.081E-05	--	--	--	4.93E-06	--	--	--
Benzo(a)anthracene								
Benzo(a)pyrene								
Benzo(b)fluoranthrene								
Benzo(k)fluoranthrene								
Chrysene								
Dibenz(a,h)anthracene								
Indeno(1,2,3-cd)pyrene								
Propylene oxide	1.787E-03	3.23E-04	5.77E-07	8.66E-06	8.16E-04	3.33E-02	2.72E-05	6.98E-06
Toluene	8.030E-03	2.70E-05	2.17E-07	3.25E-06	3.67E-03	3.33E-03	1.22E-05	3.14E-06
Xylene	3.942E-03	4.55E-05	1.79E-07	2.69E-06	1.80E-03	1.43E-03	2.57E-06	6.62E-07
		Total =	1.67E-03	2.50E-02		Total =	7.13E-03	1.83E-03

Notes:

(1) Maximum unit risk value applied to all PAHs for purposes of this analysis.

(2) Based on modeled acute health hazard index from the turbines of 0.025.

(3) Based on modeled chronic health hazard index from the turbines of 0.002.

APPENDIX 8.1D

Construction Emissions and Impact Analysis

APPENDIX 8.1D

CONSTRUCTION EMISSIONS AND IMPACT ANALYSIS

8.1D-1 Onsite Construction

Construction of the project is expected to last approximately 12 months. Construction activities will occur in the following four main phases:

- Site preparation;
- Foundation work;
- Installation of major equipment; and
- Construction/installation of major structures.

Site preparation includes grading, excavation of footings and foundations, and backfilling operations. After site preparation is finished, the construction of the foundations and structures is expected to begin. Once the foundations and structures are finished, installation and assembly of the mechanical and electrical equipment are scheduled to commence. Construction of the process water line, underground transmission line and natural gas pipeline will occur simultaneously with onsite construction.

Fugitive dust emissions from the construction of the project will result from:

- Dust entrained during site preparation and grading/excavation at the construction site;
- Dust entrained during trenching and repaving activities along the process water line and underground transmission line routes;
- Dust entrained during onsite travel on paved and unpaved surfaces;
- Dust entrained during aggregate and soil loading and unloading operations; and
- Wind erosion of areas disturbed during construction activities.

Combustion emissions during construction will result from:

- Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, trenching and construction of onsite structures;
- Exhaust from the Diesel excavator, paver, and trucks associated with process water line and underground transmission line construction;
- Exhaust from water trucks used to control construction dust emissions;
- Exhaust from Diesel-powered welding machines, electric generators, air compressors, and water pumps;
- Exhaust from pickup trucks and Diesel trucks used to transport workers and materials around the construction site;
- Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site; and
- Exhaust from automobiles used by workers to commute to the construction site.

To determine the potential worst-case daily construction impacts, exhaust and dust emission rates have been evaluated for each source of emissions. Because of the staggered construction schedule, site preparation and equipment installation may be occurring simultaneously. Therefore, maximum short-term impacts are calculated assuming that all equipment is operating simultaneously with the peak workforce (264 persons) on-site.[1] Annual emissions are based on the average equipment mix during the 12-month construction period.

8.1D-2 Linear Facilities

Offsite construction will include an underground transmission line and a process water line. Emissions from these construction activities are included in this analysis.

8.1D-3 Available Mitigation Measures

The following typical mitigation measures are proposed to control exhaust emissions from the Diesel heavy equipment and potential emissions of fugitive dust during construction of the project:

- All unpaved roads and disturbed areas in the project and linear construction sites shall be watered as frequently as necessary to prevent fugitive dust plumes. The frequency of watering can be reduced or eliminated during periods of precipitation.
- No vehicle shall exceed 10 miles per hour within the construction site.
- The construction site entrances shall be posted with visible speed limit signs.
- All construction equipment vehicle tires shall be inspected and washed as necessary to be cleaned free of dirt prior to entering paved roadways.
- Gravel ramps of at least 20 feet in length must be provided at the tire washing/cleaning station.
- All unpaved exits from the construction site shall be graveled or treated to prevent track-out to public roadways.
- All construction vehicles shall enter the construction site through the treated entrance roadways, unless an alternative route has been submitted to and approved by the Compliance Project Manager.
- Construction areas adjacent to any paved roadway shall be provided with sandbags or other measures as specified in the Storm Water Pollution Prevention Plan (SWPPP) to prevent run-off to roadways.
- All paved roads within the construction site shall be swept at least twice daily (or less during periods of precipitation) on days when construction activity occurs to prevent the accumulation of dirt and debris.
- At least the first 500 feet of any public roadway exiting from the construction site shall be swept at least twice daily (or less during periods of precipitation) on days when construction activity occurs or on any other day when dirt or runoff from the construction site is visible on the public roadways.
- All soil storage piles and disturbed areas that remain inactive for longer than 10 days shall be covered, or shall be treated with appropriate dust suppressant compounds.
- All vehicles that are used to transport solid bulk material on public roadways and that have potential to cause visible emissions shall be provided with a

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[1] Workforce includes construction personnel for plant, gas line and potable water line (onsite) and underground transmission line and process water line (offsite).

cover, or the materials shall be sufficiently wetted and loaded onto the trucks in a manner to provide at least one foot of freeboard.

- Wind erosion control techniques (such as windbreaks, water, chemical dust suppressants, and/or vegetation) shall be used on all construction areas that may be disturbed. Any windbreaks installed to comply with this condition shall remain in place until the soil is stabilized or permanently covered with vegetation.

An on-site Air Quality Construction Mitigation Manager will be responsible for directing and documenting compliance construction-related mitigation conditions.

8.1D-4 Estimates of Emissions with Mitigation Measures

8.1D-4.1 Onsite Construction

Tables 8.1D-1 and 8.1D-2 show the estimated maximum daily and annual heavy equipment exhaust and fugitive dust emissions with recommended mitigation measures for onsite construction activities. Detailed emission calculations are included as Attachment 8.1D-1.

Table 8.1D-1
Maximum Daily Emissions During Onsite Construction, Pounds Per Day

	NOx	CO	POC	SOx	PM_{10}	$PM_{2.5}$
Onsite						
Construction Equipment	67.4	39.6	7.3	0.07	4.0	4.0
Fugitive Dust	--	--	--	--	17.0	5.2
Offsite						
Worker Travel, Truck Deliveries	55.5	247.6	25.2	0.5	1.8	1.8
Total Emissions						
Total	122.9	287.2	32.5	0.6	22.8	10.9

Table 8.1D-2
Annual Emissions During Construction, Tons Per Year

	NOx	CO	POC	SOx	PM_{10}	$PM_{2.5}$
Onsite						
Construction Equipment	5.2	3.2	0.6	0.01	0.3	0.3
Fugitive Dust	--	--	--	--	1.5	0.5
Offsite						
Worker Travel, Truck Deliveries	5.6	19.0	2.0	0.05	0.2	0.2
Total Emissions						
Total	10.8	22.2	2.6	0.06	2.0	1.0

8.1D-4.2 Linear Facilities Construction

The estimated maximum daily heavy equipment exhaust and fugitive dust emissions with recommended mitigation measures for the natural gas and potable water pipeline construction activities are included in the onsite construction analysis. Table 8.1D-3 shows the estimated maximum daily equipment exhaust and fugitive dust emissions with mitigation during process water line and underground transmission line construction. Detailed emissions calculations are shown in Attachment 8.1D-1. Note that the construction of the process water and transmission lines are expected to occur concurrently only for approximately two months.

Table 8.1D-3
Maximum Daily Emissions During Water and Transmission Line Construction, Pounds Per Day

	NOx	CO	POC	SOx	PM_{10}	$PM_{2.5}$
Process Water Line						
Construction Equipment	17.3	7.6	1.3	0.06	0.7	0.7
Fugitive Dust	--	--	--	--	0.4	0.08
Worker Travel, Truck Deliveries	18.7	23.0	2.6	0.2	0.4	0.4
Underground Transmission Line						
Construction Equipment	17.3	7.6	1.3	0.06	0.7	0.7
Fugitive Dust	--	--	--	--	0.4	0.08
Worker Travel, Truck Deliveries	18.7	23.0	2.6	0.2	0.4	0.4
Total Emissions						
Total	72.0	60.2	7.8	0.5	3.0	2.5

8.1D-5 Analysis of Ambient Impacts from Onsite Construction

Ambient air quality impacts from emissions during construction of the project were estimated using an air quality dispersion modeling analysis. The modeling analysis considers the construction site location, the surrounding topography, and the sources of emissions during construction, including vehicle and equipment exhaust emissions and fugitive dust.

8.1D-5.1 Existing Ambient Levels

As with the modeling analysis of project operating impacts (Section 8.1.2), the Arkansas Street (San Francisco) monitoring station was used to establish the ambient background levels for the construction impact modeling analysis. Table 8.1-4.3 shows the maximum concentrations of NOx, SO_2, CO, and PM_{10} recorded for 2001 through 2003 at that monitoring station.[2]

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[2] Ambient background data from Arkansas Street for the 2004 calendar year is not yet available.

8.1D-5.2 Dispersion Model

As in the analysis of project operating impacts, the EPA-approved Industrial Source Complex Short Term (ISCST3) model was used to estimate ambient impacts from construction activities. A detailed discussion of the ISCST3 dispersion model is included in Section 8.1.5.3.1.

The emission sources for the construction site were grouped into three categories: exhaust emissions, construction dust emissions and windblown dust emissions. The exhaust and construction dust emissions were modeled as volume sources. The windblown dust emissions were modeled as area sources. For the volume sources, the vertical dimension was set to 6 meters. For combustion sources in the project site area, the horizontal dimension was set to 125.19 meters, with sigma-y = 33.38 meters (based on the width of the construction area). For combustion sources in the construction laydown area, the horizontal dimension was set to 209.78 meters, with sigma-y = 48.79 meters.

For the windblown dust sources, the area covers the entire site plan. An effective plume height of 0.5 meters was used in the modeling analysis. The exhaust and dust emissions were modeled as a single area source that covered the total area of the construction site, with half of the emissions allocated to the project site and half to the laydown area. The construction impacts modeling analysis used the same receptor locations as used for the project operating impact analysis. A detailed discussion of the receptor locations is included in Section 8.1.5.3.1.

To determine the construction impacts on short-term ambient standards (24 hours and less), the worst-case daily onsite construction emission levels shown in Table 8.1D-1 were used. For pollutants with annual average ambient standards, the annual onsite emission levels shown in Table 8.1D-2 were used. As with the project operating impact analysis, the meteorological data set used for the construction emission impacts analysis is the ambient data collected at the nearby Arkansas Street monitoring station between 2001 and 2003.

8.1D-4.5.3 Modeling Results

Based on the emission rates of NOx, SO_2, CO, and PM_{10} and the meteorological data, the ISCST3 model calculates hourly and annual ambient impacts for each pollutant. As mentioned above, the modeled 1-hour, 3-hour, 8-hour, and 24-hour ambient impacts are based on the worst-case daily emission rates of NOx, SO_2, CO, and PM_{10}. The annual impacts are based on the annual emission rates of these pollutants.

The one-hour and annual average concentrations of NO_2 were computed following the revised EPA guidance for computing these concentrations (August 9, 1995 *Federal Register*, 60 FR 40465). The ISC_OLM model was used for the one-hour average NO_2 impacts; uncorrected one-hour impacts are also reported for comparison. The annual average was calculated using the ambient ratio method (ARM) with the national default value of 0.75 for the annual average NO_2/NOx ratio.

The modeling analysis results are shown in Table 8.1D-4. Also included in the table are the maximum background levels that have occurred in the last 3 years and the resulting total ambient impacts. Construction impacts alone for all modeled pollutants are expected to be below the most stringent state and national standards. With the exception of the 24-hour and annual average PM_{10}, construction activities are not expected to cause the violation of any state or federal ambient air quality standard.

However, the state 24-hour and annual average PM_{10} standards are exceeded in the absence of the construction emissions for the project.

The dust mitigation measures already proposed by the applicant are expected to be very effective in minimizing fugitive dust emissions. The attached isopleth diagrams show the extent of the modeled impacts from construction PM_{10} and $PM_{2.5}$ for the 24-hour and annual averaging periods.

Table 8.1D-4

Modeled Maximum Onsite Construction Impacts

Pollutant	Averaging Time	Maximum Construction Impacts (µg/m^3)	Background (µg/m^3)	Total Impact (µg/m^3)	Standard (µg/m^3)	Federal Standard (µg/m^3)
NO_2[a]	1-hour	97.1	141	238	470	--
	Annual	2.1	36	38	--	100
SO_2	1-hour	0.4	138	138	650	--
	24-hour	0.05	29	29	109	365
	Annual	0.005	5.3	5.3	--	80
CO	1-hour	205.4	5,000	5,205	23,000	40,000
	8-hour	73.8	3,644	3,718	10,000	10,000
PM_{10}[b]	24-hour	14.2	74	88	50	150
	Annual	1.1	26.3	27	20	50
$PM_{2.5}$[b]	24-hour	6.2	58	64	--	65
	Annual	0.6	13.1	14	12	15

Notes:

a. Ozone limiting method applied for 1-hour average, using concurrent O_3 data (1992). ARM applied for annual average, using national default 0.75 ratio. Uncorrected 1-hour NOx concentration is 350 µg/m^3.

b. PM_{10} and $PM_{2.5}$ impacts shown are from fugitive dust as well as combustion sources. 24-hour average $PM_{2.5}/PM_{10}$ impact from combustion sources only is 2.7 µg/m^3.

As shown on these isopleths, while maximum impacts occur next to the project site fenceline, concentrations decrease rapidly at locations only a couple of hundred meters away from the project site. For example, maximum modeled PM_{10} impacts along the fenceline are approximately 14 µg/m^3. However, as shown on the isopleths for 24-hour average PM_{10} impacts, within 500 meters of the fenceline, 24-hour average PM_{10} impacts are below the 5 µg/m^3 PM_{10} significance threshold.

It is also important to note that emissions in an exhaust plume are dispersed through the entrainment of ambient air, which dilutes the concentration of the emissions as they are carried away from the source by winds. The process of mixing the pollutants with greater and greater volumes of cleaner air is controlled primarily by the turbulence in the atmosphere. This dispersion occurs both horizontally, as the exhaust plume rises above the emission point, and vertically, as winds carry the plume horizontally away from its source.

The rise of a plume above its initial point of release is a significant contributing factor to the reductions in ground-level concentrations, both because a rising plume entrains more ambient air as it travels downwind, and because it travels farther downwind (and thus also undergoes more horizontal dispersion) before it impacts the ground. Vertical plume rise occurs as a result of buoyancy (plume is hotter than ambient air, and hot air, being less dense, tends to rise) and/or momentum (plume has an initial vertical velocity).

In ISCST3, area sources are not considered to have either buoyant or momentum plume rise, and therefore the model assumes that there is no vertical dispersion taking place. Thus a significant source of plume dilution is ignored when sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards. The input and output modeling files are being provided electronically.

8.1D-5.4 Health Risk of Diesel Exhaust

The combustion portion of annual PM_{10} emissions from Table 8.1D-3 above was modeled separately to determine the annual average Diesel PM_{10} exhaust concentration. This was used with HARP-derived risk values for Diesel exhaust particulate[3] for a 70-year lifetime to determine the potential carcinogenic risk from Diesel exhaust during construction. The exposure was also adjusted by a factor of 12/840, or 0.0143, to correct for the 12-month exposure.

The maximum modeled annual average concentration of Diesel exhaust PM_{10} at any location is 0.1825 $\mu g/m^3$. The risk values obtained from HARP range from $2.86\text{x}10^{-4}$ (average point estimate value) to $4.15\text{x}10^{-4}$ (derived OEHHA and high end risk estimates). Using the range of risk values and adjustment factors described above, the carcinogenic risk due to exposure to Diesel exhaust during construction activities is expected to be between approximately 0.75 and 1.1 in one million. This is well below the 10 in one million level considered by the CEC and BAAQMD staffs to be significant.

It is also important to note that these impacts are highly localized near the project site. As shown in the attached annual average Diesel combustion PM_{10} isopleth diagram (Figure 8.1D-3), the area in which the risk may exceed 1 in one million (Diesel PM_{10} impact greater than or equal to 0.168 $\mu g/m^3$) extends less than 100 meters from the facility fenceline. This analysis remains conservative because, as discussed above, the modeled PM_{10} concentrations from construction operations are overpredicted by the ISCST3 model.

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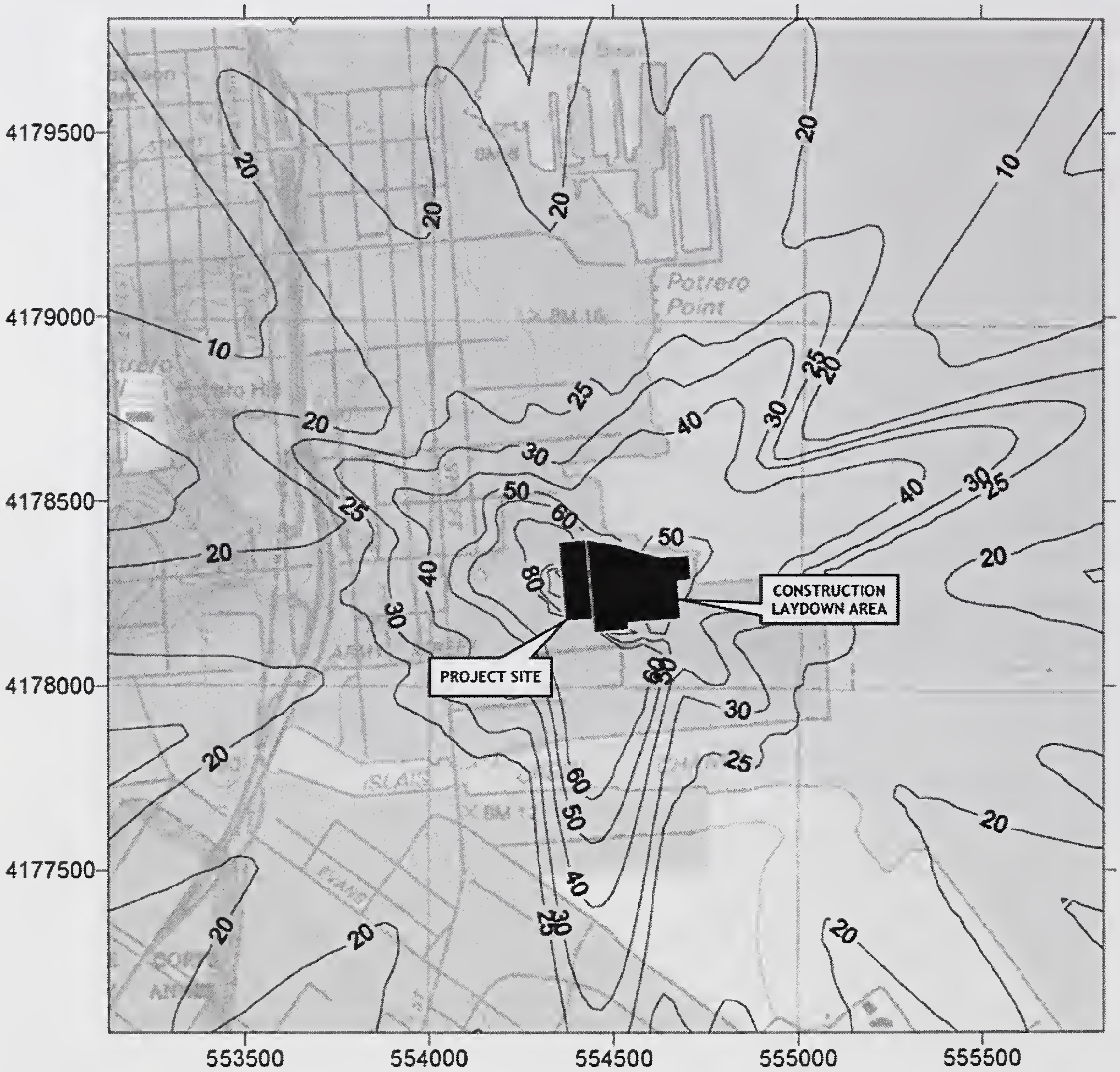
[3] See Appendix 8.1C for a discussion of the use of the HARP model to derive cancer risk values.

Figure 8.1D-1

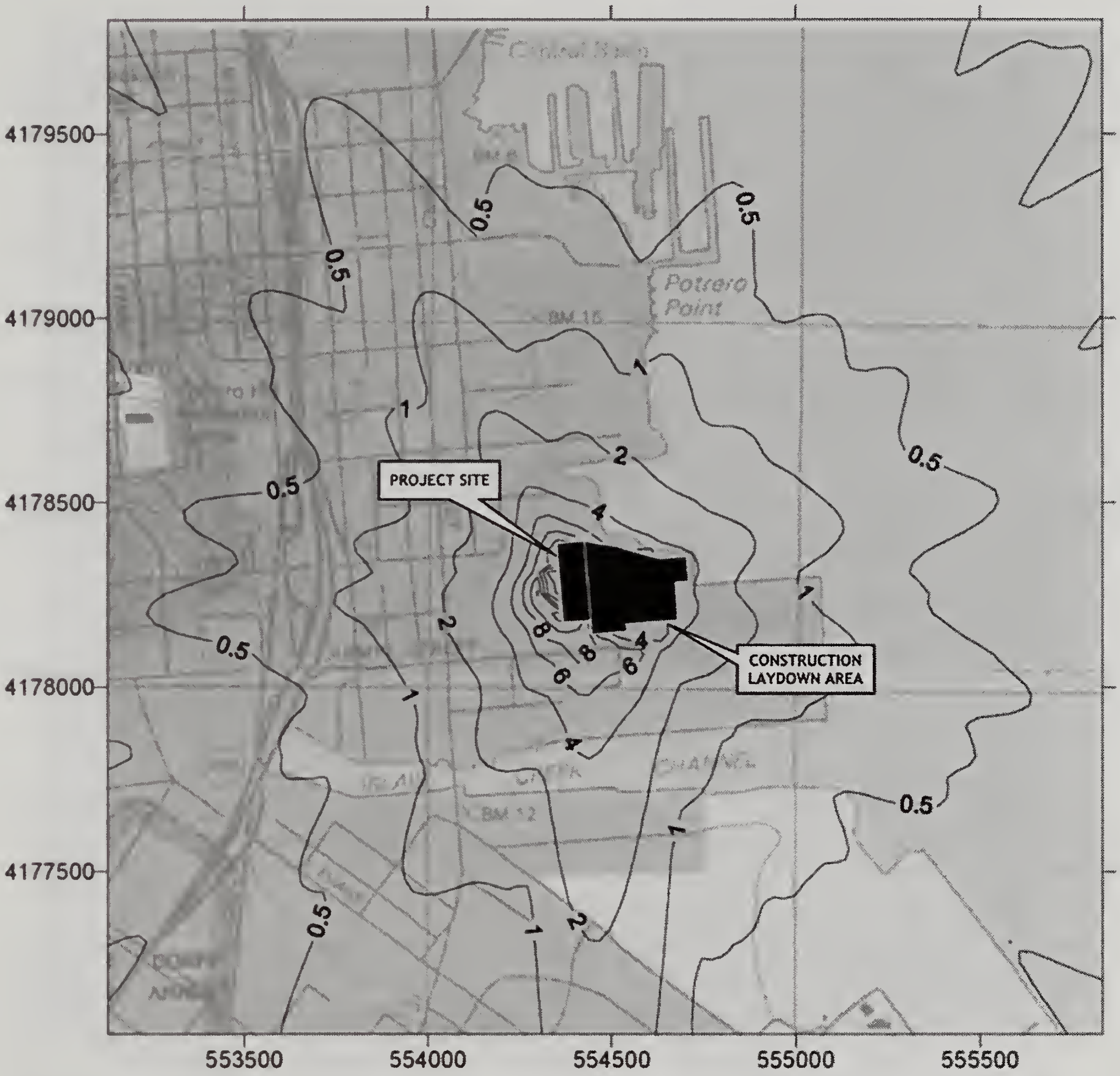
Maximum One-Hour Average NO_2 Impacts During Construction Activities (Ozone-Limited)
Concentrations in $\mu g/m^3$



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum short-term impacts are calculated assuming that all equipment is operating simultaneously with the peak workforce. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Figure 8.1D-2

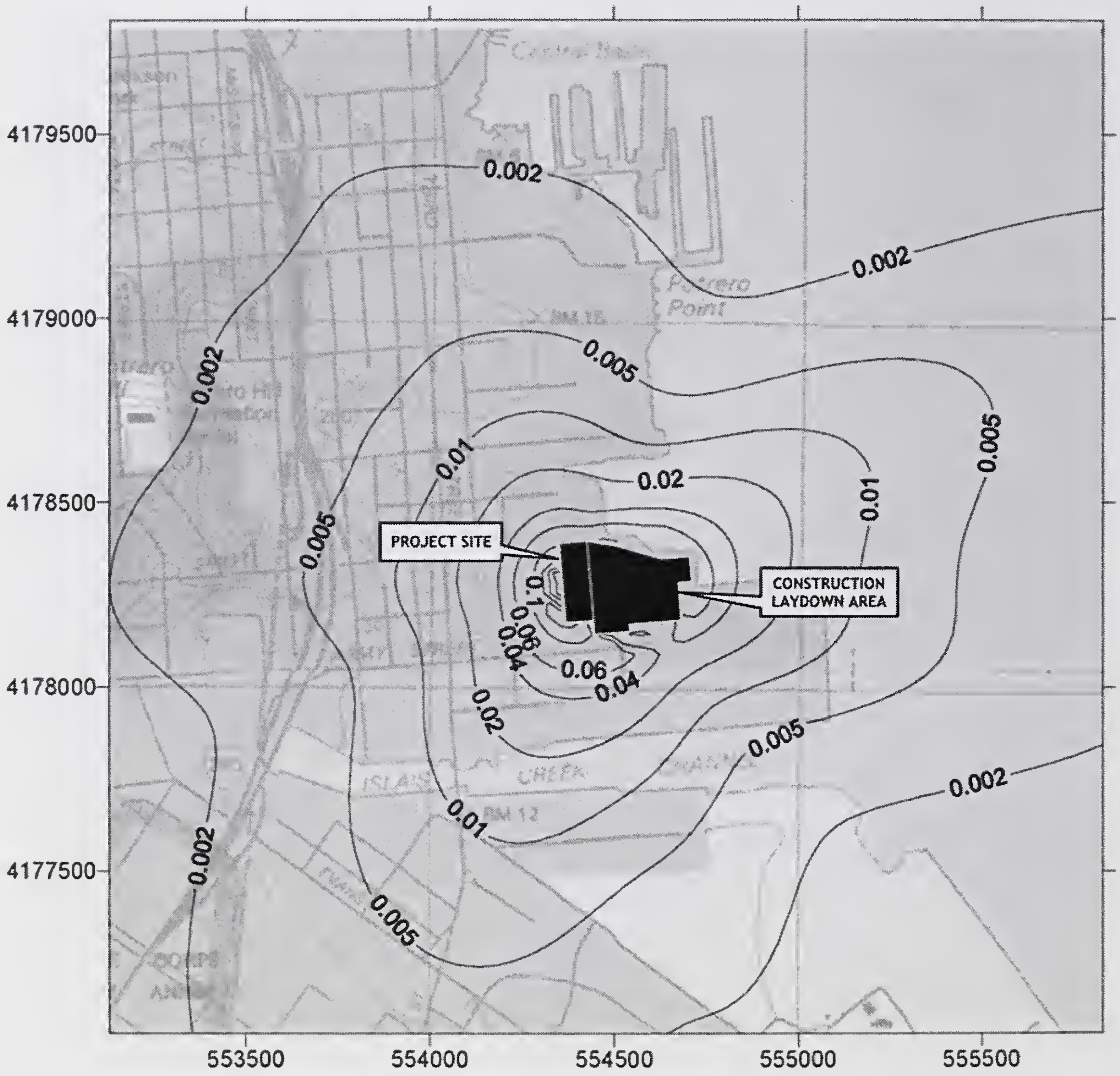
Maximum 24-Hour Average PM_{10} Impacts During Construction Activities, All Sources
Concentrations in $\mu g/m^3$



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum short-term impacts are calculated assuming that all equipment is operating simultaneously with the peak workforce. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Figure 8.1D-3a

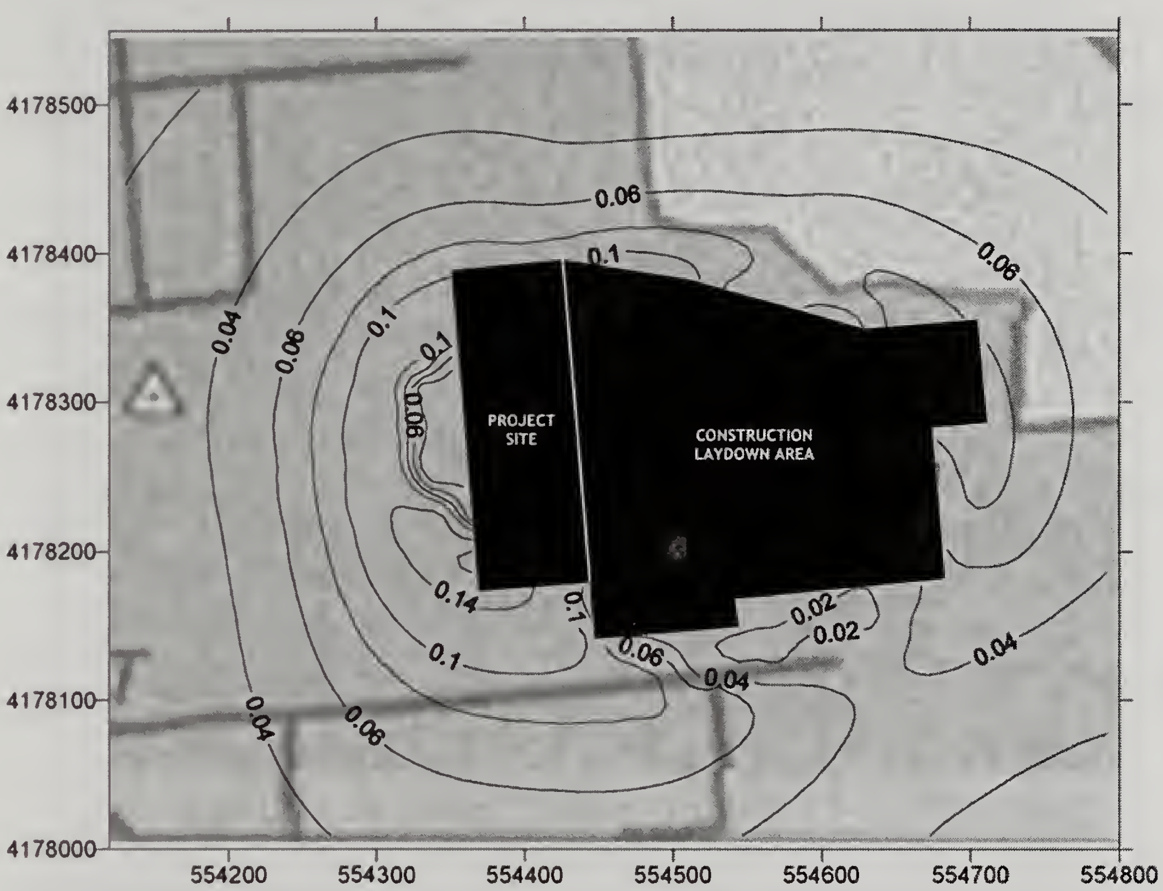
Maximum Annual Average PM_{10} Impacts During Construction Activities, Combustion Sources
Concentrations in $\mu g/m^3$



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum impacts are calculated assuming that all equipment is operating simultaneously. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Figure 8.1D-3b

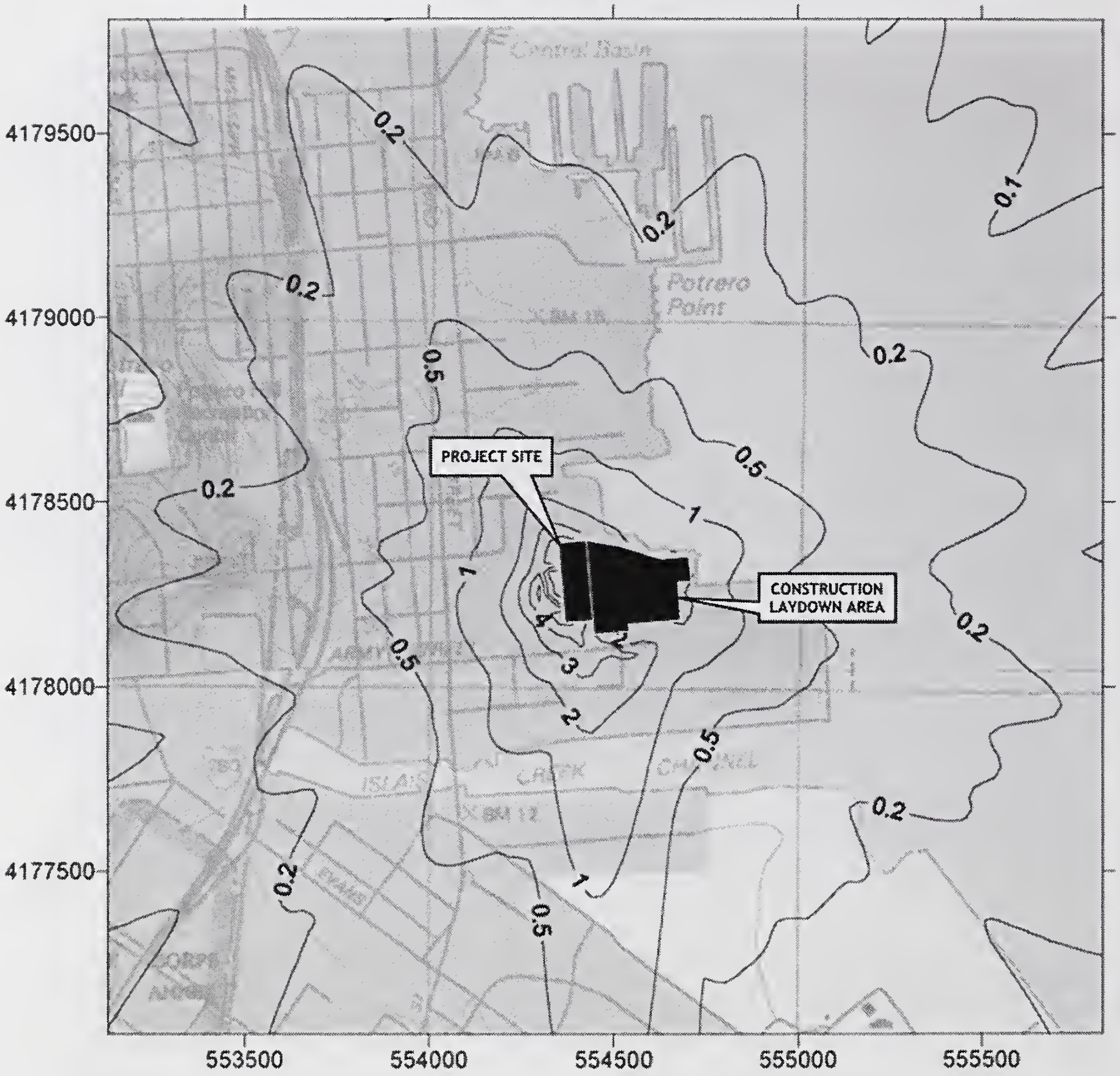
Maximum Annual Average PM_{10} Impacts During Construction Activities, Combustion Sources (detail)
Concentrations in $\mu g/m^3$



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum are calculated assuming that all equipment is operating simultaneously. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Figure 8.1D-4

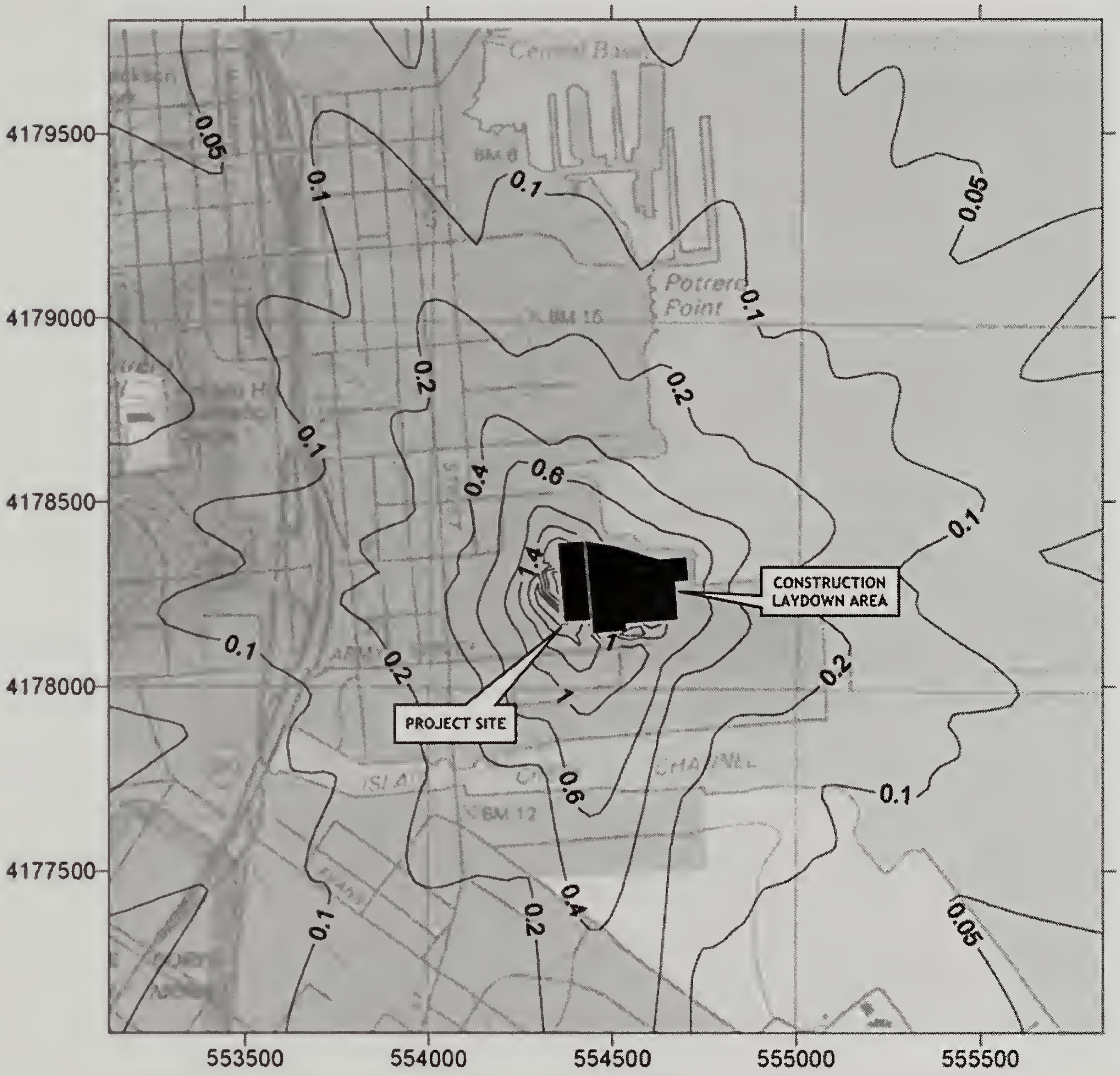
Maximum 24-Hour Average $PM_{2.5}$ Impacts During Construction Activities,
All Sources
Concentrations in $\mu g/m^3$



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum short-term impacts are calculated assuming that all equipment is operating simultaneously with the peak workforce. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Figure 8.1D-5

Maximum 24-Hour Average $PM_{10}/PM_{2.5}$ Impacts During Construction Activities, Combustion Sources
Concentrations in μg/m^3



Modeled construction impacts are conservatively high because assumptions are made for both emissions calculations and modeling techniques that tend to overpredict results. Maximum short-term impacts are calculated assuming that all equipment is operating simultaneously with the peak workforce. A significant source of plume dilution is being ignored, since the construction emissions sources are modeled as area sources. The project construction site impacts are not unusual in comparison to most construction sites; construction sites that use good dust suppression techniques and low-emitting vehicles typically do not cause violations of air quality standards.

Attachment 8.1D-1

Detailed Construction Emissions Calculations

<table>
<tr><th colspan="7">Daily Construction Emissions (peak months)</th></tr>
<tr><th colspan="7">(lbs/day)</th></tr>
<tr><th></th><th>NOx</th><th>CO</th><th>VOC</th><th>SOx</th><th>PM2.5</th><th>PM10</th></tr>
<tr><td colspan="7">Onsite</td></tr>
<tr><td>Construction Equipment</td><td>67.43</td><td>39.61</td><td>7.33</td><td>0.07</td><td>3.98</td><td>3.98</td></tr>
<tr><td>Fugitive Dust</td><td></td><td></td><td></td><td></td><td>5.16</td><td>17.03</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Subtotal =</td><td>67.43</td><td>39.61</td><td>7.33</td><td>0.07</td><td>9.15</td><td>21.01</td></tr>
<tr><td colspan="7">Offsite</td></tr>
<tr><td>Worker Travel</td><td>23.22</td><td>229.10</td><td>22.76</td><td>0.13</td><td>1.09</td><td>1.09</td></tr>
<tr><td>Truck Deliveries</td><td>32.25</td><td>18.46</td><td>2.41</td><td>0.37</td><td>0.70</td><td>0.70</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Subtotal =</td><td>55.47</td><td>247.56</td><td>25.17</td><td>0.50</td><td>1.78</td><td>1.78</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total =</td><td>122.89</td><td>287.17</td><td>32.50</td><td>0.58</td><td>10.93</td><td>22.79</td></tr>
</table>

<table>
<tr><th colspan="7">Annual Construction Emissions (peak 12-month period)
(tons/yr)</th></tr>
<tr><th></th><th>NOx</th><th>CO</th><th>VOC</th><th>SOx</th><th>PM2.5</th><th>PM10</th></tr>
<tr><td colspan="7">Onsite</td></tr>
<tr><td>Construction Equipment</td><td>5.21</td><td>3.22</td><td>0.60</td><td>0.01</td><td>0.34</td><td>0.34</td></tr>
<tr><td>Fugitive Dust</td><td></td><td></td><td></td><td></td><td>0.46</td><td>1.50</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Subtotal =</td><td>5.21</td><td>3.22</td><td>0.60</td><td>0.01</td><td>0.79</td><td>1.84</td></tr>
<tr><td colspan="7">Offsite</td></tr>
<tr><td>Worker Travel</td><td>1.70</td><td>16.76</td><td>1.66</td><td>0.01</td><td>0.08</td><td>0.08</td></tr>
<tr><td>Truck Deliveries</td><td>3.87</td><td>2.22</td><td>0.29</td><td>0.04</td><td>0.08</td><td>0.08</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Subtotal =</td><td>5.57</td><td>18.97</td><td>1.95</td><td>0.05</td><td>0.16</td><td>0.16</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total =</td><td>10.77</td><td>22.19</td><td>2.56</td><td>0.06</td><td>0.96</td><td>2.00</td></tr>
</table>

Dust Emission Ranking

Equipment	Hrs/Day Per Unit (1)	PM10 lbs/hr Per Unit	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Grader	7	0.06	0.45	0.45	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dozer	7	0.42	2.94	2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper	7	0.83	5.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vibrator	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forklift	7	0.18	0.00	0.00	1.27	3.81	3.81	3.81	3.81	3.81	3.81	3.81	2.54	0.00
Backhoe	7	0.19	0.00	0.00	3.99	3.99	3.99	3.99	3.99	3.99	3.99	2.66	0.00	0.00
Crane	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loader	7	0.04	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Field truck (3/4T)	7	0.13	0.88	0.88	0.88	0.88	0.88	1.76	1.76	1.76	1.76	0.88	0.88	0.88
Dump truck	7	0.19	1.36	1.36	1.36	2.71	2.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water truck	7	0.30	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11	0.00	0.00
Service truck	7	0.09	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.00	0.00	0.00
Fuel Truck	7	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00
Boom truck	7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Concrete pump	7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port air compressor	7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Port. Light plant	7	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Total =	10.3	4	7	9	9	9.6	10	10	10	7	3	1
			100%	41%	64%	84%	84%	93%	93%	93%	93%	71%	33%	9%
		12-month Total =												88

Note: (1) 7 hours of equipment operation during 10 hrs/day of construction activity.

Daily Fugitive Dust Emissions (peak month)

Equipment	Number of Units	Daily Process Rate Per Unit	Total Process Rate	Units	PM2.5 Emission Factor(1) (lbs/unit)	PM10 Emission Factor(1) (lbs/unit)	Control Factor(1) (%)	PM2.5 Emissions (lbs/day)	PM10 Emissions (lbs/day)
Backhoe	0	882.0	0.0	tons	5.305E-05	0.0015	0%	0.00	0.00
Grader	1	21.0	21.0	vmt	0.0193297	0.2754	92%	0.03	0.45
Dozer	1	7.0	7.0	hr	0.23	0.4194	0%	1.62	2.94
Scraper - Excavation	1	7.0	7.0	hr	0.23	0.4194	0%	1.62	2.94
Scraper - Unpaved Road Travel	1	10.6	10.6	vmt	0.53	3.4638	92%	0.44	2.86
Loader - Excavation	1	735.0	735.0	tons	2.827E-05	0.0001	0%	0.02	0.07
Loader - Unpaved Road Travel	1	1.3	1.3	vmt	0.29	1.9201	92%	0.03	0.20
Water Truck Unpaved Road Travel	1	9.5	9.5	vmt	0.44	2.8400	92%	0.32	2.11
Forklift Unpaved Road Travel	0	9.5	0.0	vmt	0.26	1.7100	92%	0.00	0.00
Dump Truck Unpaved Road Travel	1	5.6	5.6	vmt	0.46	2.9806	92%	0.20	1.29
Dump Truck Unloading	1	735.0	735.0	tons	2.827E-05	0.0001	0%	0.02	0.07
3/4 ton Truck Unpaved Road Travel	1	11.4	11.4	vmt	0.15	0.9947	92%	0.13	0.88
3 ton Truck Unpaved Road Travel	1	5.7	5.7	vmt	0.22	1.4328	92%	0.10	0.63
Fuel Truck Unpaved Road Travel	1	0.1	0.1	vmt	0.33	2.1349	92%	0.00	0.02
Windblown Dust (active construction area)	N/A	728,462.8	728,462.8	sq.ft.	6.728E-06	1.682E-05	92%	0.38	0.95
Worker Gravel Road Travel	203	0.1	23.1	vmt	0.12	0.7705	92%	0.21	1.38
Delivery Truck Gravel Road Travel	6.5	0.1	0.7	vmt	0.35	2.3088	92%	0.02	0.13
Delivery Truck Unpaved Road Travel	6.5	0.1	0.5	vmt	0.46	2.9806	92%	0.02	0.11
Total =								5.16	17.03

Notes:
(1) See notes for fugitive dust emission calculations.

Annual Fugitive Dust Emissions

Activity	Average Daily PM2.5 Emissions(1) (lbs/day)	Average Daily PM10 Emissions(1) (lbs/day)	Days per Year	Annual PM2.5 Emissions (tons/yr)	Annual PM10 Emissions (tons/yr)
Construction Activities	3.41	11.47	240	0.41	1.38
Windblown Dust	0.27	0.68	365	0.05	0.12
Total =				0.46	1.50

Notes:
(1) Based on average of daily emissions during 12-month construction period.

Notes - Fugitive Dust Emission Calculations

Wind erosion of active construction area - 'Source: "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996

Level 2 Emission Factor = 0.011 ton/acre-month
Construction Schedule = 30 days/month
= 0.7 lbs/acre-day
= 1.682E-05 PM10 lbs/scf-day
6.728E-06 PM2.5 lbs/scf-day

Material Unloading - Source: AP-42, p. 13.2.4-3, 1/95

E = (k)(0.0032)[(U/5)^1.3]/[(M/2)^1.4
k = particle size constant = 0.35 for PM10
k = particle size constant = 0.11 for PM2.5
U = average wind speed = 2.81 m/sec (based on project area wind data)
= 6.29 mph
M = moisture content = 15.0% (SCAQMD CEQA Handbook, Table A9-9-G-1, moist soil)
E = PM10 emission factor = 0.0001 lb/ton
E = PM2.5 emission factor = 0.00003 lb/ton

Loader Unpaved Road Travel - Source: AP-42, Section 13.2.2, 12/03

E = (k)[(s/12)^0.9][(W/3)^0.45]

k = particle size constant = 1.5 for PM10
k = particle size constant = 0.23 for PM2.5
s = surface silt content = 8.50 (AP-42, Table 13.2.2-1, 12/03, construction haul route)

W = avg. vehicle weight = 10.35 tons (avg. of loaded and unloaded weights, 966F loader, Caterpillar Performance Handbook, 10/97)
E = PM10 emission factor = 1.92 lb PM10/VMT
E = PM2.5 emission factor = 0.29 lb PM2.5/VMT

Soil Density = 1.05 ton/yd3 (Caterpillar Performance Handbook, 10/89)
Loader Bucket Capacity = 5 yd3 (966F loader, Caterpillar Performance Handbook, 10/97)
= 5.25 ton/load
Daily Soil Transfer Rate = 735 ton/day (operating 7 hrs/day)
Daily Loader Trips = 140 loading trips/day

Loading Travel Distance = 50 ft/load (estimated)
Daily Loader Travel Distance = 7,000 ft/day
= 1.3 mi/day

Notes - Fugitive Dust Emission Calculations
Backhoe Trenching - Source: AP-42, Table 11.9-1 (dragline operations), 7/98

$E = (0.75)(0.0021)(d^{0.7})/(M^{0.3})$

d = drop height = 3 ft (estimated)
M = moisture content = 15.0% (SCAQMD CEQA Handbook, Table A9-9-G-1, moist soil)
E = PM10 emission factor = 0.0015 PM10 lb/ton
E = PM2.5 emission factor = 0.0001 PM2.5 lb/ton
Backhoe Excavating Rate = 120.0 yd3/hr (based on 1 yd3 bucket on a 416C backhoe and a 30 sec. Cycle time)

= 840 yd3/day for 1 backhoe @ 7 hrs/day of operation
Soil Density = 1.0500 ton/yd3 (Caterpillar Performance Handbook, 10/89)
Daily Soil Transfer Rate = 882.0000 ton/day (estimated)

Unpaved Road Travel - Source: AP-42, Section 13.2.2, 12/03.

$E = (k)[(s/12)^{0.9}*(W/3)^{0.45}$

k = particle size constant = 1.5 for PM10
k = particle size constant = 0.23 for PM2.5
s = silt fraction = 8.50 (AP-42, Table 13.2.2-1, 12/03, constructic

W = water truck avg. veh. weight = 10.0 tons empty (estimated)
= 39.4 tons loaded (estimated with 8,000 gallon water capacity)
= 24.7 tons average

W = dump truck avg. veh. weight = 15.0 tons (for heavy duty Diesel trucks)
= 40.0 tons (for heavy duty Diesel trucks)
= 27.5 tons (for heavy duty Diesel trucks)
W = forklift avg. veh. weight = 8.0 tons empty (estimated)
W = auto/pickup avg. vehicle weight = 2.4 tons (CARB Area Source Manual, 9/97)
W = delivery truck avg. veh. wt. = 27.5 tons (for heavy duty Diesel trucks)
W = 3 ton truck avg. veh. Wt = 5.4 tons (estimate)
W = scraper avg. veh. wt. = 28.2 tons empty (615 scraper, Caterpillar Performance Handbook, 10/89)
48.6 tons loaded (615 scraper, Caterpillar Performance Handbook, 10/89)
38.4 tons mean weight
W = fuel truck avg. veh. weight = 8.0 tons empty (estimated)
= 18.2 tons loaded (estimated with 3,000 gallons Diesel fuel capacity)
= 13.1 tons average

Gravel Road Travel - Source: AP-42, Section 13.2.2, 12/03.

$E = (k)[(s/12)^{0.9}*(W/3)^{0.45}$

k = particle size constant = 1.5 for PM10
k = particle size constant = 0.23 for PM2.5
s = silt fraction = 6.40 (AP-42, Table 13.2.2-1, 12/03, gravel road)

W = water truck avg. veh. weight = 10.0 tons empty (estimated)
= 39.4 tons loaded (estimated with 8,000 gallon water capacity)
= 24.7 tons average

W = dump truck avg. veh. weight = 15.0 tons (for heavy duty Diesel trucks)
= 40.0 tons (for heavy duty Diesel trucks)
= 27.5 tons (for heavy duty Diesel trucks)
W = forklift avg. veh. weight = 8.0 tons empty (estimated)
W = auto/pickup avg. vehicle weight = 2.4 tons (CARB Area Source Manual, 9/97)
W = delivery truck avg. veh. wt. = 27.5 tons (for heavy duty Diesel trucks)

Notes - Fugitive Dust Emission Calculations

E = water truck emission factor = 2.84 lb PM10/VMT
E = dump truck emission factor = 2.98 lb PM10/VMT
E = forklift emiss. factor = 1.71 lb PM10/VMT
E = auto/pickup emiss. factor = 0.99 lb PM10/VMT
E = delivery truck emiss. factor = 2.98 lb PM10/VMT
E = 3-ton truck emiss. factor = 1.43 lb PM10/VMT
E = scaper emiss. factor = 3.46 lb PM10/VMT
E = fuel truck emiss. factor = 2.13 lb PM10/VMT

E = water truck emission factor = 0.44 lb PM2.5/VMT
E = dump truck emission factor = 0.46 lb PM2.5/VMT
E = forklift emiss. factor = 0.26 lb PM2.5/VMT
E = auto/pickup emiss. factor = 0.15 lb PM2.5/VMT
E = delivery truck emiss. factor = 0.46 lb PM2.5/VMT
E = 3-ton truck emiss. factor = 0.22 lb PM2.5/VMT
E = scaper emiss. factor = 0.53 lb PM2.5/VMT
E = fuel truck emiss. factor = 0.33 lb PM2.5/VMT

E = auto/pickup emiss. factor = 0.77 lb PM10/VMT
E = delivery truck emiss. factor = 2.31 lb PM10/VMT

E = auto/pickup emiss. factor = 0.12 lb PM2.5/VMT
E = delivery truck emiss. factor = 0.35 lb PM2.5/VMT

Unpaved Road Travel and Active Excavation Area Control - Source: Control of Open Fugitive Dust Sources, U.S EPA, 9/88

$C = 100 - (0.8)(p)(d)(t)/(i)$

p = potential average hourly daytime
evaporation rate = 0.3575 mm/hr (EPA document, Figure 3-2, summer)
evaporation rate = 0.2695 mm/hr (EPA document, Figure 3-2, annual)
d = average hourly daytime traffic rate = 37.0 vehicles/hr (estimated)
t = time between watering applications = 1.00 hr/application (estimated)
i = application intensity = 1.4 L/m2 (typical level in EPA document, page 3-23)
C = average summer watering control efficien 92.2%
C = average annual watering control efficienc 94.1%

Finish Grading - Source: AP-42, Table 11.9-1, 7/98

$E = (0.60)(0.051)(S^{2.0})$

S = mean vehicle speed = 3.0 mph (estimate)
E = emission factor = 0.2754 PM10 lb/VMT
E = emission factor = 0.0193 PM2.5 lb/VMT

Notes - Fugitive Dust Emission Calculations

Bulldozer Operation and Scraper Excavation - Source: AP-42, Table 11.9.1, 7/98

E = (0.75)(s^1.5)/(M^1.4)

s = silt content = 8.5% (AP-42, Table 13.2.2-1, 9/98, construction haul route)
M = moisture content = 15.0% (SCAQMD CEQA Handbook, Table A9-9-G-1)
E = emission factor = 0.42 PM10 lb/hr
E = emission factor = 0.23 PM2.5 lb/hr

Scraper Travel

W = mean vehicle weight = 28.2 tons empty (615E scraper, Caterpillar Performance Handbook, 10/89)
= 48.6 tons loaded (615E scraper, Caterpillar Performance Handbook, 10/89)
= 38.4 tons mean weight

Daily Scraper Haul Tonnage = 1,428 ton/day (estimated)

Scraper Load = 20.4 ton (615E scraper, Caterpillar Performance Handbook, 10/89)

Daily Scraper Loads = 70.00 loads/day

Daily Scraper Hauling Distance = 0.08 miles/load (estimated)

Daily Scraper Travel = 10.61 miles/day

Notes - Fugitive Dust Emission Calculations

(1) Wind erosion emission factor for active construction area is based on "Improvement of Specific Emission Factors (BACM Project No. 1), Final Report", prepared for South Coast AQMD by Midwest Research Institute, March 1996.
(2) Material unloading emission factors are based on AP-42, p. 13.2.4-3, 1/95.
(Based on average annual wind speed recorded onsite and default soil moisture contents.)
(3) Trenching emission factor is based on AP-42, Table 11.9-2 (dragline operations), 1/95.
(Based on default soil moisture content.)
(4) Unpaved surface travel emission factors for water trucks, loaders, dump trucks, forklifts, delivery trucks, are based on AP-42, Section 13.2.2, 12/2003.
(Based on default soil silt content.)
(5) Dust control efficiency for unpaved road travel and active excavation area is based on "Control of Open Fugitive Dust Sources", U.S. EPA, 9/88.
(Based on default evaporation rate shown in EPA document, Figure 3-2, 9/88, and typical water application rate shown in EPA document, page 3-23, 9/88.)

Combustion Emission Ranking

Equipment	Hrs/Day Per Unit (1	Gals/Hr Per Unit	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Grader	7	5.00	35	35	35	0	0	0	0	0	0	0	0	0
Dozer	7	5.50	39	39	0	0	0	0	0	0	0	0	0	0
Scraper	7	9.00	63	0	0	0	0	0	0	0	0	0	0	0
Vibrator	7	0.25	2	2	0	0	0	0	0	0	0	0	0	0
Forklift	7	2.50	0	0	18	53	53	53	53	53	53	53	35	0
Backhoe	7	2.50	0	0	53	53	53	53	53	53	53	35	0	0
Crane	7	5.00	0	0	35	35	70	70	70	70	35	0	0	0
Loader	7	2.50	18	0	0	0	0	0	0	0	0	0	0	0
Field truck (3/4T)	7	0.78	5	5	5	5	5	11	11	11	11	5	5	5
Dump truck	7	3.13	22	22	22	44	44	0	0	0	0	0	0	0
Water truck	7	3.13	22	22	22	22	22	22	22	22	22	22	0	0
Service truck	7	1.56	11	11	11	11	11	11	11	11	11	0	0	0
Fuel Truck	7	3.13	22	22	22	22	22	22	22	22	22	22	0	0
Boom truck	7	1.56	0	0	0	11	11	11	11	11	11	11	0	0
Concrete pump	7	3.13	0	22	44	44	44	22	22	0	0	0	0	0
Port air compressor	7	1.27	9	9	9	9	9	9	9	9	9	9	0	0
Port. Light plant	7	1.27	9	9	9	9	9	9	9	9	9	9	0	0
		Total =	256	197	284	317	352	291	291	269	234	165	40	5
		12-month Total =												2702

Note: (1) 7 hours of equipment operation during 10 hrs/day of construction activity.

Notes - Combustion Emissions

(1) For Construction Equipment
For Diesel construction equipment, emission factors based on equipment meeting EPA Tier I off-road Diesel standards and use of CARB ultra low-sulfur fuel.
For trucks, depending on size of truck, emissions factors based on EMFAC 2002 v.2.2 for heavy-heavy duty or medium duty Diesel trucks, fleet average for calendar year 2005.

(2) For Delivery Trucks
From EMFAC 2002 V.2.2, heavy-heavy duty Diesel trucks, fleet average for calendar year 2005, San Francisco Air Basin.

(3) For Worker Travel
From EMFAC 2002 v.2.2, average of light duty automobiles and light duty trucks, fleet average for calendar year 2005.

	Emission Factors (1)				
	NOx	CO	VOC	SOx	PM10
Truck Hauling (lbs/vmt)	0.03543	0.02029	0.00264	0.00041	0.00077
Truck Hauling (lbs/1000 gals)	167.27418	95.77071	12.48315	1.93738	3.61512

Notes:
(1) From EMFAC 2002 V.2.2, heavy-heavy duty Diesel trucks, fleet average for calendar year 2005, San Francisco Air Basin.

	Emission Factors				
	NOx	CO	POC	SOx	PM10
Light Duty Trucks/Cars (lbs/vmt)(1)	0.00163	0.01612	0.00160	0.00001	0.00008
Light Duty Trucks (lbs/1000 gals)(2)	41.87820	369.45051	33.92633	0.19942	1.62860
Medium Duty Trucks (lbs/1000 gals)(3)	40.59	262.67	25.01	0.21	1.32

Notes:
(1) From EMFAC 2002 v.2.2, average of light duty automobiles and light duty trucks, fleet average for calendar year 2005, San Franciso Air Basin.
(2) From EMFAC 2002 v2.2, light duty trucks (gasoline and Diesel), fleet average for calendar year 2005, San Francisco Air Basin.
(3) From EMFAC 2002 v2.2, medium duty trucks (gasoline and Diesel), fleet average for calendar year 2005, San Franciso Air Basin.

Gasoline Equipment Factors - Small Engines

			(gm/bhp-hr)		
	NOx	CO	POC	SO2	PM10
Small Equipment(1) (g/bhp-hr)	2.03	353.00	19.13	0.00	0.06
Small Equipment(1) (lb/1000 gal)	79.44	13813.38	748.58	0.00	2.35

Notes:

(1) From EPA's "Non-road Engine and Vehicle Emission Study Report", 11/91, Table 2-07, for generator sets, welders, pumps, and air compressors less than 50 hp.

Worker Travel Daily Emissions (Maximum Monthly)

Number of Workers Per Day(1)	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Vehicle Miles Traveled Per Day (Miles)	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
					NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
264	1.3	203	70	14215	0.0016	0.0161	0.0016	0.0000	0.0001	23.22	229.10	22.76	0.13	1.09

Notes:
(1) See notes for combustion emissions.

Worker Travel Annual Emissions

Average Number of Workers Per Day	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Days per Year	Vehicle Miles Traveled Per Year	Emission Factors (lbs/vmt)(1)					Annual Emissions (tons/yr)				
						NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
161	1.3	124	70	240	2,079,538	0.0016	0.0161	0.0016	0.0000	0.0001	1.70	16.76	1.66	0.01	0.08

Notes:
(1) See notes for combustion emissions.

Delivery Truck Daily Emissions (Maximum Monthly)

Number of Deliveries Per Day(1)	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
13	70	910	0.0354	0.0203	0.0026	0.0004	0.0008	32.25	18.46	2.41	0.37	0.70
Idle exhaust (2)												0.0546

Notes:
(1) See notes for combustion emissions.
(2) 13 trucks per day times 1 hr idle time per visit times 0.0042 lb/hr.

Delivery Truck Annual Emissions

Average Number of Deliveries Per Year	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Year	Emission Factors (lbs/vmt)(1)					Annual Emissions (tons/yr)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
3120	70	218400.00	0.0354	0.0203	0.0026	0.0004	0.0008	3.87	2.22	0.29	0.04	0.08
Idle exhaust (2,3)												0.00655

Notes:
(1) See notes for combustion emissions.
(2) Annual average of 10 trucks per day, 240 days per year times 1 hr idle time per visit times 0.0042 lb/hr
(3) Based on 1.91 g/hr idle emission rate for the composite HDD truck fleet in 2001 from EPA's PART5 model.

Title San Francisco Air Basin Avg 2005 Annual Default Title
Version . Emfac2002 V2 2 Apr 23 2003
Run Date 01/16/04 15 15.53
Scen Year 2005 -- Model Years. 1965 to 2005
Season . Annual
Area : San Francisco Air Basin Average
I/M Stat : I and M program in effect
Emissions: Tons Per Day

	LDA-NCAT	LDA-CAT	LDA-DSL	LDA-TOT	LDT1-NCAT	LDT1-CAT	LDT1-DSL	LDT1-TOT	LDT2-NCAT	LDT2-CAT	LDT2-DSL
Vehicles	67414	2972660	15394	3055470	23488	580582	14396	618465	12480	711733	8207
VMT/1000	790	100533	324	101647	410	19137	402	19949	224	24540	284
Trips	287679	18757200	88176	19133100	101829	3639110	88494	3829430	55412	4517670	51784
Reactive Organic Gas Emissions											
Run Exh	4.9	16.99	0.09	21.99	2.52	4.44	0.07	7.03	1.33	4.66	0.03
Idle Exh	0	0	0	0	0	0	0	0	0	0	0
Start Ex	1.72	21.34	0	23.06	0.59	4.53	0	5.12	0.3	5.43	0
Total Ex	6.62	38.33	0.09	45.05	3.11	8.97	0.07	12.15	1.63	10.09	0.03
Diurnal	0.39	3.12	0	3.51	0.13	0.72	0	0.85	0.07	0.63	0
Hot Soak	0.9	2.72	0	3.61	0.32	0.66	0	0.98	0.17	0.57	0
Running	5.65	17.42	0	23.06	1.25	5.85	0	7.11	0.55	5.37	0
Resting	0.19	1.16	0	1.35	0.07	0.29	0	0.35	0.03	0.23	0
Total	13.74	62.75	0.09	76.58	4.87	16.5	0.07	21.44	2.46	16.9	0.03
Carbon Monoxide Emissions											
Run Exh	63.55	439.06	0.28	502.89	33.49	134.92	0.3	168.71	17.89	132.33	0.17
Idle Exh	0	0	0	0	0	0	0	0	0	0	0
Start Ex	9.55	224.61	0	234.16	3.44	58.78	0	62.21	1.84	61.47	0
Total Ex	73.1	663.67	0.28	737.05	36.93	193.7	0.3	230.93	19.73	193.79	0.17
Oxides of Nitrogen Emissions											
Run Exh	4	51.66	0.49	56.15	2.04	15.7	0.56	18.31	1.09	22.43	0.42
Idle Exh	0	0	0	0	0	0	0	0	0	0	0
Start Ex	0.46	12.77	0	13.23	0.16	2.74	0	2.9	0.09	5.16	0
Total Ex	4.46	64.43	0.49	69.37	2.2	18.45	0.56	21.21	1.18	27.59	0.42
Carbon Dioxide Emissions (000)											
Run Exh	0.43	40.37	0.13	40.93	0.22	9.32	0.15	9.7	0.12	11.99	0.11
Idle Exh	0	0	0	0	0	0	0	0	0	0	0
Start Ex	0.06	1.55	0	1.61	0.02	0.36	0	0.39	0.01	0.45	0
Total Ex	0.49	41.92	0.13	42.54	0.24	9.68	0.15	10.08	0.13	12.44	0.11
PM10 Emissions											
Run Exh	0.03	1.12	0.05	1.2	0.01	0.23	0.03	0.28	0.01	0.55	0.02
Idle Exh	0	0	0	0	0	0	0	0	0	0	0
Start Ex	0	0.13	0	0.14	0	0.03	0	0.03	0	0.06	0
Total Ex	0.03	1.25	0.05	1.34	0.02	0.26	0.03	0.31	0.01	0.61	0.02
TireWear	0.01	0.89	0	0.9	0	0.17	0	0.18	0	0.22	0
BrakeWr	0.01	1.39	0	1.41	0.01	0.26	0.01	0.28	0	0.34	0
Total	0.05	3.53	0.06	3.64	0.02	0.69	0.04	0.76	0.01	1.16	0.02
Lead	0	0	0	0	0	0	0	0	0	0	0
SOx	0.01	0.41	0.01	0.43	0	0.1	0.01	0.11	0	0.12	0.01
Fuel Consumption (000 gallons)											
Gasoline	63.96	4411.67	0	4475.63	31.81	1025.72	0	1057.53	17.29	1308.48	0
Diesel	0	0	11.73	11.73	0	0	13.89	13.89	0	0	9.79

Title : San Francisco Air Basin Avg 2005 Annual Default Title
Version : Emfac2002 V2.2 Apr 23 2003
Run Date : 01/16/04 15:15:53
Scen Year: 2005 -- Model Years: 1965 to 2005
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	LDT2-TOT	MDV-NCAT	MDV-CAT	MDV-DSL	MDV-TOT	LHDT1-NC	LHDT1-CA	LHDT1-DS	LHDT1-TO	LHDT2-NC	LHDT2-CA	LHDT2-DS	LHDT2-TO	MHDT-NCA	MHDT-CAT	MHDT-DSL	MHDT-TOT	HHDT-NCA	HHDT-CAT	HHDT-DSL
Vehicles	732420	5615	363369	11141	380125	1438	34381	6749	42569	7	8851	6875	15733	2194	10708	36009	48912	438	3084	28936
VMT/1000	25048	103	12439	409	12952	12	1977	457	2446	0	437	361	798	19	483	2180	2681	6	260	4462
Trips	4624860	25852	2304600	71509	2401960	47566	1136880	84893	1269340	227	292681	86478	379386	100213	489018	1009700	1598930	20018	140854	146430
Reactive Or																				
Run Exh	6.02	0.71	3.18	0.04	3.93	0.1	0.46	0.18	0.74	0	0.26	0.19	0.45	0.14	0.4	0.82	1.36	0.1	0.91	3.31
Idle Exh	0	0	0	0	0	0	0.05	0	0.05	0	0.01	0	0.01	0	0.02	0.02	0.05	0	0	0.24
Start Ex	5.73	0.17	3.67	0	3.84	0.4	0.69	0	1.08	0	0.29	0	0.29	1.24	0.93	0	2.17	0.42	0.72	0
Total Ex	11.76	0.88	6.84	0.04	7.76	0.5	1.2	0.18	1.88	0	0.56	0.19	0.75	1.38	1.36	0.83	3.58	0.51	1.63	3.55
Diurnal	0.7	0.02	0.34	0	0.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot Soak	0.75	0.05	0.33	0	0.39	0.04	0.05	0	0.09	0	0.03	0	0.03	0.05	0.04	0	0.09	0.01	0.02	0
Running	5.92	0.17	2.89	0	3.07	0.33	0.8	0	1.13	0	0.49	0	0.49	0.46	0.94	0	1.4	0.11	0.42	0
Resting	0.27	0.01	0.13	0	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	19.39	1.14	10.55	0.04	11.72	0.87	2.04	0.18	3.1	0	1.07	0.19	1.27	1.89	2.35	0.83	5.07	0.64	2.07	3.55
Carbon Mon																				
Run Exh	150.39	12.71	71.01	0.23	83.95	2.01	5.26	0.58	7.85	0.01	3.4	0.56	3.97	3.32	7.03	5.27	15.61	3.35	12.88	13.28
Idle Exh	0	0	0	0	0	0.01	0.3	0.01	0.32	0	0.08	0.01	0.08	0.03	0.15	0.1	0.28	0	0	1.42
Start Ex	63.31	1.32	37.82	0	39.14	2.24	8.86	0	11.1	0.01	3.9	0	3.91	7.08	16.68	0	23.76	5.79	11.23	0
Total Ex	213.7	14.04	108.83	0.23	123.09	4.27	14.42	0.58	19.27	0.02	7.38	0.57	7.96	10.43	23.85	5.37	39.65	9.13	24.12	14.7
Oxides of Ni																				
Run Exh	23.94	0.71	14.69	0.62	16.02	0.03	0.92	2.92	3.87	0	0.52	2.45	2.97	0.08	1.86	26.82	28.76	0.15	4.09	73.67
Idle Exh	0	0	0	0	0	0	0	0.02	0.02	0	0	0.02	0.02	0	0	0.31	0.31	0	0	4.34
Start Ex	5.25	0.06	2.95	0	3	0.04	1.65	0	1.69	0	0.6	0	0.6	0.12	1.67	0	1.79	0.1	1.41	0
Total Ex	29.19	0.76	17.64	0.62	19.02	0.07	2.58	2.94	5.59	0	1.12	2.47	3.59	0.2	3.53	27.13	30.86	0.24	5.5	78.01
Carbon Dio																				
Run Exh	12.22	0.06	8.41	0.16	8.63	0.01	2.11	0.26	2.39	0	0.47	0.22	0.68	0.01	0.36	3.62	4	0	0.17	10.63
Idle Exh	0	0	0	0	0	0	0.01	0	0.01	0	0	0	0	0	0	0.02	0.02	0	0	0.22
Start Ex	0.46	0.01	0.32	0	0.32	0.01	0.05	0	0.06	0	0.01	0	0.01	0.02	0.02	0	0.04	0	0.01	0
Total Ex	12.68	0.07	8.73	0.16	8.95	0.02	2.17	0.26	2.46	0	0.48	0.22	0.7	0.04	0.39	3.63	4.06	0.01	0.17	10.85
PM10 Emiss																				
Run Exh	0.57	0	0.27	0.02	0.3	0	0.02	0.04	0.06	0	0.01	0.04	0.05	0	0.01	0.78	0.79	0	0	1.46
Idle Exh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.1
Start Ex	0.06	0	0.03	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Ex	0.63	0	0.3	0.02	0.33	0	0.03	0.04	0.06	0	0.01	0.04	0.05	0	0.01	0.79	0.8	0	0.01	1.56
TireWear	0.22	0	0.11	0	0.11	0	0.03	0.01	0.03	0	0.01	0	0.01	0	0.01	0.03	0.04	0	0	0.18
BrakeWr	0.35	0	0.17	0.01	0.18	0	0.03	0.01	0.03	0	0.01	0	0.01	0	0.01	0.03	0.04	0	0	0.06
Total	1.2	0.01	0.59	0.03	0.62	0	0.08	0.05	0.13	0	0.02	0.05	0.07	0	0.02	0.85	0.87	0	0.01	1.8
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOx	0.13	0	0.09	0.01	0.1	0	0.02	0.02	0.04	0	0	0.02	0.02	0	0	0.32	0.33	0	0	0.97
Fuel Consur																				
Gasoline	1325.77	9.72	913.43	0	923.15	3.28	224.71	0	227.99	0.02	50.63	0	50.65	5.95	44.13	0	50.08	2.46	22.01	0
Diesel	9.79	0	0	14.07	14.07	0	0	23.79	23.79	0	0	19.53	19.53	0	0	326.88	326.88	0	0	976.88

Title : San Francisco Air Basin Avg 2005 Annual Default Title
Version : Emfac2002 V2.2 Apr 23 2003
Run Date : 01/16/04 15:15:53
Scen Year: 2005 -- Model Years: 1965 to 2005
Season : Annual
Area : San Francisco Air Basin Average
I/M Stat : I and M program in effect
Emissions: Tons Per Day

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	HHDT-TOT	LHV-NCAT	LHV-CAT	LHV-DSL	LHV-TOT	SBUS-NCA	SBUS-CAT	SBUS-DSL	SBUS-TOT	UB-NCAT	UB-CAT	UB-DSL	UB-TOT	MH-NCAT	MH-CAT	MH-DSL	MH-TOT	MCY-NCAT	MCY-CAT	MCY-DSL	MCY-TOT	ALL-TOT
Vehicles	32458	0	0	0	0	141	671	4354	5167	233	2412	5089	7734	4722	37360	2432	44513	64415	11530	0	75945	5059510
VMT/1000	4727	0	0	0	0	6	28	177	210	28	296	621	945	58	515	35	607	467	103	0	570	172581
Trips	307302	0	0	0	0	565	2685	17416	20666	931	9648	20357	30936	472	3737	243	4453	128818	23057	0	151875	33752200
Reactive Or																						
Run Exh	4.32	0	0	0	0	0.05	0.05	0.08	0.19	0.29	0.74	0.74	1.77	0.41	0.4	0.01	0.82	2.02	0.21	0	2.23	50.84
Idle Exh	0.24	0	0	0	0	0	0.01	0.01	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0.37
Start Ex	1.14	0	0	0	0	0.01	0.01	0	0.02	0.02	0.05	0	0.06	0.01	0.01	0	0.01	0.4	0.07	0	0.47	42.99
Total Ex	5.69	0	0	0	0	0.06	0.07	0.09	0.23	0.31	0.79	0.74	1.84	0.42	0.41	0.01	0.83	2.43	0.27	0	2.7	94.2
Diurnal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0.01	0.09	0.07	0	0.16	5.61
Hot Soak	0.03	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0.1	0.02	0	0.11	6.09
Running	0.53	0	0	0	0	0.01	0.01	0	0.02	0.02	0.02	0	0.04	0	0.01	0	0.01	0.64	0.14	0	0.78	43.56
Resting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0.02	0	0.06	2.17
Total	6.25	0	0	0	0	0.07	0.09	0.09	0.25	0.33	0.82	0.74	1.88	0.42	0.43	0.01	0.85	3.3	0.52	0	3.82	151.63
Carbon Mon																						
Run Exh	29.51	0	0	0	0	1.14	0.81	0.52	2.47	5.9	5.59	3	14.49	10.06	12.29	0.05	22.4	26.58	2.83	0	29.41	1031.65
Idle Exh	1.42	0	0	0	0	0.01	0.06	0.07	0.13	0	0	0	0	0	0	0	0	0	0	0	0	2.23
Start Ex	17.02	0	0	0	0	0.06	0.19	0	0.25	0.09	0.79	0	0.88	0.03	0.13	0	0.16	1.18	0.47	0	1.65	457.55
Total Ex	47.95	0	0	0	0	1.21	1.05	0.59	2.85	5.99	6.37	3	15.36	10.09	12.42	0.05	22.56	27.76	3.3	0	31.07	1491.43
Oxides of Ni																						
Run Exh	77.9	0	0	0	0	0.02	0.12	2.33	2.47	0.12	1.38	15.73	17.24	0.23	1.46	0.43	2.12	0.69	0.16	0	0.85	250.59
Idle Exh	4.34	0	0	0	0	0	0	0.21	0.21	0	0	0	0	0	0	0	0	0	0	0	0	4.91
Start Ex	1.51	0	0	0	0	0	0.01	0	0.01	0	0.07	0	0.08	0	0.01	0	0.01	0.05	0	0	0.05	30.12
Total Ex	83.75	0	0	0	0	0.02	0.13	2.54	2.69	0.12	1.46	15.73	17.31	0.24	1.46	0.43	2.13	0.74	0.16	0	0.9	285.62
Carbon Dio›																						
Run Exh	10.8	0	0	0	0	0	0.02	0.29	0.32	0.02	0.24	1.91	2.17	0.04	0.39	0.06	0.49	0.06	0.01	0	0.07	92.4
Idle Exh	0.22	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0.27
Start Ex	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0.01	2.91
Total Ex	11.03	0	0	0	0	0.01	0.02	0.3	0.33	0.02	0.24	1.91	2.18	0.04	0.39	0.06	0.49	0.06	0.02	0	0.08	95.58
PM10 Emiss																						
Run Exh	1.46	0	0	0	0	0	0	0.09	0.09	0	0.01	0.29	0.3	0	0	0.01	0.01	0.03	0	0	0.03	5.14
Idle Exh	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.11
Start Ex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.27
Total Ex	1.56	0	0	0	0	0	0	0.09	0.09	0	0.01	0.29	0.3	0	0	0.01	0.01	0.03	0	0	0.03	5.52
TireWear	0.18	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0	0	0	0	1.69
BrakeWr	0.07	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0.01	0	0.01	0.01	0	0	0.01	2.39
Total	1.81	0	0	0	0	0	0	0.1	0.1	0	0.01	0.31	0.32	0	0.02	0.01	0.03	0.04	0	0	0.04	9.6
Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOx	0.97	0	0	0	0	0	0	0.03	0.03	0	0	0.17	0.17	0	0	0.01	0.01	0	0	0	0	2.36
Fuel Consur																						
Gasoline	24.47	0	0	0	0	0.75	2.75	0	3.5	3.47	26.3	0	29.78	6.23	41.94	0	48.18	11.92	2.2	0	14.11	8230.84
Diesel	976.88	0	0	0	0	0	0	27.3	27.3	0	0	171.69	171.69	0	0	5.18	5.18	0	0	0	0	1600.74

Onsite Combustion Emissions

			Base Factors g/bhp, if Tier 1 >50 hp (1)						Appendix A Table A3 Adjustment (2)						Adjustment (3)	Adjusted Factors					
Equipment	HP Cat.	Tier	BSFC lb/h	NOx	CO	VOC	SOx	PM10	Adj. Type	NOx	CO	VOC	SOx	PM10	PM10 Fuel S	BSFC	NOx	CO	VOC	SOx	PM10
Crane	175-300	1	0.367	5.5772	0.7475	0.3085	0.00499	0.2521	None	1	1	1	1	1	-0.086	0.367	5.58	0.75	0.31	0.0049	0.17
Wrecking Ball	175-300	1	0.367	5.5772	0.7475	0.3085	0.00499	0.2521	None	1	1	1	1	1	-0.086	0.367	5.58	0.75	0.31	0.0049	0.17
Dozer	100-175	1	0.367	5.6523	0.8667	0.3384	0.00499	0.2799	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.37	1.33	0.36	0.0049	0.26
Scraper	175-300	1	0.367	5.5772	0.7475	0.3085	0.00499	0.2521	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.30	1.14	0.32	0.0049	0.22
Grader	100-175	1	0.367	5.6523	0.8667	0.3384	0.00499	0.2799	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.37	1.33	0.36	0.0049	0.26
Backhoe	50-100	1	0.408	5.5988	2.3655	0.5213	0.00555	0.473	Lo LF	1.1	2.57	2.29	1.18	1.97	-0.113	0.481	6.16	6.08	1.19	0.0064	0.82
Loader	50-100	1	0.408	5.5988	2.3655	0.5213	0.00555	0.473	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.096	0.412	5.32	3.62	0.55	0.0055	0.49
Truck- Water	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Forklift	50-100	1	0.408	5.5988	2.3655	0.5213	0.00555	0.473	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.096	0.412	5.32	3.62	0.55	0.0055	0.49
Dump Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Service Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Boom Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Truck- Fuel/Lube	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Concrete Pumper Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Trucks- Pickup 3/4 ton	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Vibrator	25-50	0	0.408	6.9	5	1.8	0.00555	0.8	None	1	1	1	1	1	-0.094	0.40	6.90	5.00	1.80	0.0053	0.71
Light Plants	25-50	0	0.408	6.9	5	1.8	0.00555	0.8	None	1	1	1	1	1	-0.094	0.40	6.90	5.00	1.80	0.0053	0.71
Air Compressor	25-50	0	0.408	6.9	5	1.8	0.00555	0.8	None	1	1	1	1	1	-0.094	0.40	6.90	5.00	1.80	0.0053	0.71

		Adjusted factors lbs/1000 gallon (4)					Total Daily Fuel Use(5) (Gals/day)	Daily Emissions Lbs/day					Total Annual Fuel Use(6) (Gals/yr)	Annual Emissions Lbs/yr				
Equipment	Tier	NOx	CO	VOC	SOx	PM10		NOx	CO	VOC	SOx	PM10		NOx	CO	VOC	SOx	PM10
Crane	1	237.87	31.88	13.16	0.21	7.09	70.00	16.65	2.23	0.92	0.01	0.50	7,700	1831.58	245.48	101.31	1.60	54.60
Dozer	1	226.75	56.00	15.00	0.21	10.88	0.00	0.00	0.00	0.00	0.00	0.00	1,540	349.19	86.23	23.11	0.32	16.75
Scraper	1	223.74	48.29	13.68	0.21	9.43	0.00	0.00	0.00	0.00	0.00	0.00	1,260	281.91	60.85	17.24	0.26	11.88
Grader	1	226.75	56.00	15.00	0.21	10.88	0.00	0.00	0.00	0.00	0.00	0.00	2,100	476.17	117.59	31.51	0.44	22.84
Backhoe	1	200.23	197.65	38.81	0.21	26.63	52.50	10.51	10.38	2.04	0.01	1.40	8,050	1611.86	1591.09	312.44	1.67	214.40
Loader	1	202.03	137.47	20.79	0.21	18.44	0.00	0.00	0.00	0.00	0.00	0.00	350	70.71	48.12	7.28	0.07	6.45
Truck- Water	na	167.27	95.77	12.48	0.21	3.62	21.91	3.66	2.10	0.27	0.00	0.08	4,382	733.00	419.67	54.70	0.92	15.84
Forklift	1	202.03	137.47	20.79	0.21	18.44	52.50	10.61	7.22	1.09	0.01	0.97	8,400	1697.08	1154.78	174.65	1.74	154.87
Dump Truck	na	167.27	95.77	12.48	0.21	3.62	43.82	7.33	4.20	0.55	0.01	0.16	3,067	513.10	293.77	38.29	0.64	11.09
Service Truck	na	74.40	59.47	5.57	0.21	4.83	10.92	0.81	0.65	0.06	0.00	0.05	1,966	146.25	116.89	10.94	0.41	9.50
Boom Truck	na	167.27	95.77	12.48	0.21	3.62	10.92	1.83	1.05	0.14	0.00	0.04	1,529	255.73	146.41	19.08	0.32	5.53
Truck- Fuel/Lube	na	167.27	95.77	12.48	0.21	3.62	21.91	3.66	2.10	0.27	0.00	0.08	4,382	733.00	419.67	54.70	0.92	15.84
Concrete Pumper Truck	na	167.27	95.77	12.48	0.21	3.62	43.82	7.33	4.20	0.55	0.01	0.16	3,944	659.70	377.70	49.23	0.83	14.26
Trucks- Pickup 3/4 ton	na	41.88	369.45	33.93	0.20	1.63	5.46	0.23	2.02	0.19	0.00	0.01	1,747	73.17	645.50	59.28	0.35	2.85
Vibrator	0	270.01	195.66	70.44	0.21	27.64	0.00	0.00	0.00	0.00	0.00	0.00	70	18.90	13.70	4.93	0.01	1.94
Light Plants	0	270.01	195.66	70.44	0.21	27.64	8.89	2.40	1.74	0.63	0.00	0.25	1,778	480.07	347.88	125.24	0.37	49.15
Air Compressor	0	270.01	195.66	70.44	0.21	27.64	8.89	2.40	1.74	0.63	0.00	0.25	1,778	480.07	347.88	125.24	0.37	49.15
Total =							351.54	67.43	39.61	7.33	0.07	3.93	54,042.80	10,411.48	6,433.20	1,209.15	11.24	656.93
														5.21	3.22	0.60	0.01	0.33 tons/yr

(1) - Steady State Emission Factors from Table A2 of EPA November 2002 NR-009b Publication.
(2) - In use adjustment factors per Table A3 EPA November 2002 NR-009b Publication.
(3) - PM10 and SO2 adjustments due to Equation 5 and Equation 7 on pages 18 and 19, Respectively of EPA Report No. NR-009b
(4) - Calculation uses adjusted BSFC and assumed 7.1 lbs/gallon. The onroad emission factors are not adjusted
(5) - Daily fuel use based on peak combustion month equipment schedule.
(6) - Annual fuel use based on average level during peak 12-month period.

Construction Equipment Daily Fuel Use (peak period)

Equipment	Gasoline/ Diesel	Number of Units	Hrs/Day Per Unit	Gals/Hr Per Unit	Total Fuel Use (Gals/day)
Grader	D	0	7	5.00	0.00
Dozer	D	0	7	5.50	0.00
Scraper	D	0	7	9.00	0.00
Vibrator	D	0	7	0.25	0.00
Forklift	D	3	7	2.50	52.50
Backhoe	D	3	7	2.50	52.50
Crane	D	2	7	5.00	70.00
Loader	D	0	7	2.50	0.00
Field truck (3/4T)	D	1	7	0.78	5.46
Dump truck	D	2	7	3.13	43.82
Water truck	D	1	7	3.13	21.91
Service truck	D	1	7	1.56	10.92
Fuel Truck	D	1	7	3.13	21.91
Boom truck	D	1	7	1.56	10.92
Concrete pump	D	2	7	3.13	43.82
Port air compressor	D	1	7	1.27	8.89
Port. Light plant	D	1	7	1.27	8.89
Total =					351.54

Construction Equipment Annual Fuel Use (12-month construction period)

Equipment	Gasoline/ Diesel	12-Month Average Number of Units Per Year(1)	Peak 12-Month Average Number of Units Per Year(1)	Average Operating Hrs/Day Per Unit	Gals/Hr Per Unit	Average Operating Days per Year	12-Month Average Total Fuel Use (Gals/yr)	Peak 12-Month Average Total Fuel Use (Gals/yr)
Grader	D	0.25	0.25	7	5.00	240	2,100	2,100
Dozer	D	0.17	0.17	7	5.50	240	1,540	1,540
Scraper	D	0.08	0.08	7	9.00	240	1,260	1,260
Vibrator	D	0.17	0.17	7	0.25	240	70	70
Forklift	D	2.00	2.00	7	2.50	240	8,400	8,400
Backhoe	D	1.92	1.92	7	2.50	240	8,050	8,050
Crane	D	0.92	0.92	7	5.00	240	7,700	7,700
Loader	D	0.08	0.08	7	2.50	240	350	350
Field truck (3/4T)	D	1.33	1.33	7	0.78	240	1,747	1,747
Dump truck	D	0.58	0.58	7	3.13	240	3,067	3,067
Water truck	D	0.83	0.83	7	3.13	240	4,382	4,382
Service truck	D	0.75	0.75	7	1.56	240	1,966	1,966
Fuel Truck	D	0.83	0.83	7	3.13	240	4,382	4,382
Boom truck	D	0.58	0.58	7	1.56	240	1,529	1,529
Concrete pump	D	0.75	0.75	7	3.13	240	3,944	3,944
Port air compressor	D	0.83	0.83	7	1.27	240	1,778	1,778
Port. Light plant	D	0.83	0.83	7	1.27	240	1,778	1,778
Total =							54,043	54,043

SFPUC - Construction Modeling
MUNI Site

Short Term Impacts (24 hours and less)					
	NOx	CO	SOx	PM2.5	PM10
Combustion (lbs/day)	67.4	39.6	0.07	3.98	3.98
Construction Dust (lbs/day)				4.78	16.07
Windblown Dust (lbs/day)				0.38	0.95

Long Term Impacts (annual)					
	NOx	CO	SOx	PM2.5	PM10
Combustion (tons/yr)	5.21	3.22	0.01	0.34	0.34
Construction Dust (tons/yr)				0.41	1.38
Windblown Dust (tons/yr)				0.05	0.12

Daily Transmission Line Construction Emissions (lbs/day)						
	NOx	CO	VOC	SOx	PM2.5	PM10
Onsite						
Construction Equipment	17.29	7.60	1.31	0.06	0.69	0.69
Fugitive Dust					0.08	0.45
Subtotal =	17.29	7.60	1.31	0.06	0.78	1.15
Offsite						
Worker Travel	1.32	13.02	1.29	0.01	0.06	0.06
Truck Deliveries	17.36	9.94	1.30	0.20	0.38	0.38
Subtotal =	18.68	22.96	2.59	0.21	0.44	0.44
Total =	35.97	30.56	3.90	0.27	1.21	1.59

Underground Transmission Line Construction - Delivery Truck Daily Emissions

Number of Deliveries Per Day(1)	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
7	70	490	0.0354	0.0203	0.0026	0.0004	0.0008	17.36	9.94	1.30	0.20	0.38
Idle exhaust (2)												0.0294

Notes:
(1) See notes for combustion emissions.
(2) 7 trucks per day times 1 hr idle time per visit times 0.0042 lb/hr.

Underground Transmission Line Construction - Worker Travel Daily Emissions

Number of Workers Per Day(1)	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Vehicle Miles Traveled Per Day (Miles)	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
					NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
15	1.3	12	70	808	0.0016	0.0161	0.0016	0.0000	0.0001	1.32	13.02	1.29	0.01	0.06

Notes:
(1) See notes for combustion emissions.

Underground Transmission Line Construction - Combustion Emissions

			Base Factors g/bhp, if Tier 1 >50 hp (1)						Appendix A Table A3 Adjustment (2)						Adjustment (3)	Adjusted Factors					
Equipment	HP Cat.	Tier	BSFC lb/hp-hr	NOx	CO	VOC	SOx	PM10	Adj. Type	NOx	CO	VOC	SOx	PM10	PM10 Fue	BSFC	NOx	CO	VOC	SOx	PM10
Excavator	175-300	1	0.367	5.5772	0.7475	0.3085	0.00499	0.2521	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.30	1.14	0.32	0.0049	0.22
Roller	100-175	1	0.367	5.6523	0.8667	0.3384	0.00499	0.2799	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.37	1.33	0.36	0.0049	0.26
Water Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Service Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Trucks- Pickup	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad

		Adjusted factors lbs/1000 gallon (4)					Total Daily Fuel Use(5) (Gals/day)	Daily Emissions Lbs/day				
Equipment	Tier	NOx	CO	VOC	SOx	PM10		NOx	CO	VOC	SOx	PM10
Excavator	1	223.74	48.29	13.68	0.21	9.43	38.50	8.61	1.86	0.53	0.01	0.36
Roller	1	226.75	56.00	15.00	0.21	10.88	17.50	3.97	0.98	0.26	0.00	0.19
Water Truck	na	167.27	95.77	12.48	1.94	3.62	21.91	3.66	2.10	0.27	0.04	0.08
Service Truck	na	74.40	59.47	5.57	0.21	4.83	10.92	0.81	0.65	0.06	0.00	0.05
Trucks- Pickup	na	41.88	369.45	33.93	0.20	1.63	5.46	0.23	2.02	0.19	0.00	0.01
Total =							94.29	17.29	7.60	1.31	0.06	0.69

(1) - Steady State Emission Factors from Table A2 of EPA November 2002 NR-009b Publication.
(2) - In use adjustment factors per Table A3 EPA November 2002 NR-009b Publication.
(3) - PM10 and SO2 adjustments due to Equation 5 and Equation 7 on pages 18 and 19, Respectively of EPA Report No. NR-009b
(4) - Calculation uses adjusted BSFC and assumed 7.1 lbs/gallon. The onroad emission factors are not adjusted.
(5) - Based on 7 hrs/day of equipment operation.

Process Water Line Construction - Daily Fugitive Dust Emissions

Equipment	Number of Units	Daily Process Rate Per Unit	Total Process Rate	Units	PM2.5 Emission Factor(1) (lbs/unit)	PM10 Emission Factor(1) (lbs/unit)	Control Factor(1) (%)	PM2.5 Emissions (lbs/day)	PM10 Emissions (lbs/day)
Excavator	1	662	662	tons	2.82661E-05	8.99E-05	0%	0.02	0.06
Pickup Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.15	0.99	92%	0.01	0.07
Service Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.22	1.43	92%	0.02	0.11
Water Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.44	2.84	92%	0.03	0.21
Windblown Dust (active construction area)	N/A	5,000	5,000	sq.ft.	6.72783E-06	1.68E-05	92%	0.00	0.01
Total =								0.08	0.45

Notes:

(1) See notes for fugitive dust emission calculations.

Daily Process Water Line Construction Emissions						
(lbs/day)						
	NOx	CO	VOC	SOx	PM2.5	PM10
Onsite						
Construction Equipment	17.29	7.60	1.31	0.06	0.69	0.69
Fugitive Dust					0.08	0.45
Subtotal =	17.29	7.60	1.31	0.06	0.78	1.15
Offsite						
Worker Travel	1.32	13.02	1.29	0.01	0.06	0.06
Truck Deliveries	17.36	9.94	1.30	0.20	0.38	0.38
Subtotal =	18.68	22.96	2.59	0.21	0.44	0.44
Total =	35.97	30.56	3.90	0.27	1.21	1.59

Process Water Line Construction - Delivery Truck Daily Emissions

Number of Deliveries Per Day(1)	Average Round Trip Haul Distance (miles)	Vehicle Miles Traveled Per Day	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
			NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
7	70	490	0.0354	0.0203	0.0026	0.0004	0.0008	17.36	9.94	1.30	0.20	0.38
Idle exhaust (2)												0.0294

Notes:
(1) See notes for combustion emissions.
(2) 7 trucks per day times 1 hr idle time per visit times 0.0042 lb/hr.

Process Water Line Construction - Worker Travel Daily Emissions

Number of Workers Per Day(1)	Average Vehicle Occupancy (person/veh.)	Number of Round Trips Per Day	Average Round Trip Haul Distance (Miles)	Vehicle Miles Traveled Per Day (Miles)	Emission Factors (lbs/vmt)(1)					Daily Emissions (lbs/day)				
					NOx	CO	POC	SOx	PM10	NOx	CO	POC	SOx	PM10
15	1.3	12	70	808	0.0016	0.0161	0.0016	0.0000	0.0001	1.32	13.02	1.29	0.01	0.06

Notes:
(1) See notes for combustion emissions.

Process Water Line Construction - Combustion Emissions

			Base Factors g/bhp, if Tier 1 >50 hp (1)						Appendix A Table A3 Adjustment (2)						Adjustment (3)	Adjusted Factors					
Equipment	HP Cat.	Tier	BSFC lb/hp-hr	NOx	CO	VOC	SOx	PM10	Adj. Type	NOx	CO	VOC	SOx	PM10	PM10 Fue	BSFC	NOx	CO	VOC	SOx	PM10
Excavator	175-300	1	0.367	5.5772	0.7475	0.3085	0.00499	0.2521	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.30	1.14	0.32	0.0049	0.22
Roller	100-175	1	0.367	5.6523	0.8667	0.3384	0.00499	0.2799	Hi LF	0.95	1.53	1.05	1.01	1.23	-0.087	0.371	5.37	1.33	0.36	0.0049	0.26
Water Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Service Truck	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad
Trucks- Pickup	Onroad	na	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad	Onroad

		Adjusted factors lbs/1000 gallon (4)					Total Daily Fuel Use(5) (Gals/day)	Daily Emissions Lbs/day				
Equipment	Tier	NOx	CO	VOC	SOx	PM10		NOx	CO	VOC	SOx	PM10
Excavator	1	223.74	48.29	13.68	0.21	9.43	38.50	8.61	1.86	0.53	0.01	0.36
Roller	1	226.75	56.00	15.00	0.21	10.88	17.50	3.97	0.98	0.26	0.00	0.19
Water Truck	na	167.27	95.77	12.48	1.94	3.62	21.91	3.66	2.10	0.27	0.04	0.08
Service Truck	na	74.40	59.47	5.57	0.21	4.83	10.92	0.81	0.65	0.06	0.00	0.05
Trucks- Pickup	na	41.88	369.45	33.93	0.20	1.63	5.46	0.23	2.02	0.19	0.00	0.01
Total =							94.29	17.29	7.60	1.31	0.06	0.69

(1) - Steady State Emission Factors from Table A2 of EPA November 2002 NR-009b Publication.
(2) - In use adjustment factors per Table A3 EPA November 2002 NR-009b Publication.
(3) - PM10 and SO2 adjustments due to Equation 5 and Equation 7 on pages 18 and 19, Respectively of EPA Report No. NR-009b
(4) - Calculation uses adjusted BSFC and assumed 7.1 lbs/gallon. The onroad emission factors are not adjusted.
(5) - Based on 7 hrs/day of equipment operation.

Process Water Line Construction - Daily Fugitive Dust Emissions

Equipment	Number of Units	Daily Process Rate Per Unit	Total Process Rate	Units	PM2.5 Emission Factor(1) (lbs/unit)	PM10 Emission Factor(1) (lbs/unit)	Control Factor(1) (%)	PM2.5 Emissions (lbs/day)	PM10 Emissions (lbs/day)
Excavator	1	662	662	tons	2.82661E-05	8.99E-05	0%	0.02	0.06
Pickup Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.15	0.99	92%	0.01	0.07
Service Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.22	1.43	92%	0.02	0.11
Water Truck Unpaved Road Travel	1	0.9	0.9	vmt	0.44	2.84	92%	0.03	0.21
Windblown Dust (active construction area)	N/A	5,000	5,000	sq.ft.	6.72783E-06	1.68E-05	92%	0.00	0.01
Total =								0.08	0.45

Notes:

(1) See notes for fugitive dust emission calculations.

APPENDIX 8.1E

Evaluation of Best Available Control Technology

APPENDIX 8.1E

EVALUATION OF BEST AVAILABLE CONTROL TECHNOLOGY

Rule 2-2-301 requires the application of BACT to any new or modified emissions unit if the new unit or modification results in an increase in permitted daily emissions greater than 10 pounds per day. BACT is defined in Rule 2-2-206 as the most stringent emission limitation or control technique of the following:

206.1 The most effective emission control device or technique which has been successfully utilized for the type of equipment comprising such a source; or

206.2 The most stringent emission limitation achieved by an emission control device or technique for the type of equipment comprising such a source; or

206.3 Any emission control device or technique determined to be technologically feasible and cost-effective by the APCO; or

206.4 The most effective emission control limitation for the type of equipment comprising such a source which the EPA states, prior to or during the public comment period, is contained in an approved implementation plan of any state, unless the applicant demonstrates to the satisfaction of the APCO that such limitations are not achievable. Under no circumstances shall the emission control required be less stringent than the emission control required by any applicable provision of federal, state or District laws, rules or regulations.

The SFERP will have emissions in excess of 10 lb/day for NOx, POC, CO, PM_{10}, and SOx. Therefore, BACT will be required for these pollutants. The emission rates determined to be BACT for this project are summarized below. The information considered in making these determinations is discussed in detail in the following sections.

- NOx emission limit of 2.5 ppmv @ 15% O_2 constitutes BACT for natural gas-fired LM6000 combustion turbines in simple cycle. At a design exhaust NOx concentration of 2.5 ppmv at 15% O_2, the proposed project will comply with the BACT NOx emission limit.
- POC emission limit of 2 ppmv @ 15% O_2 constitutes BACT for natural gas-fired simple cycle combustion turbines. At a design exhaust POC concentration of 2 ppmv at 15% O_2, the proposed modification will comply with the BACT VOC emission limit.
- CO emission limit of 4 ppmv @ 15% O_2 constitutes BACT for natural gas-fired simple cycle combustion turbines. At a design exhaust CO concentration of 4 ppmv at 15% O_2, the proposed project will comply with the BACT CO emission limit.
- The use of natural gas with an annual average sulfur content of 0.33 grains per 100 scf constitutes BACT for this project. District BACT Guideline 89.1.3 specifies BACT 2 (achieved in practice) for SO_2 for simple cycle gas turbines with an output rating of > 50 MW as the exclusive use of clean-burning natural gas.
- BACT for PM_{10} is the use of natural gas as the fuel source.

8.1E.1 Top-Down BACT Analysis for Control of Nitrogen Oxides

The following "top-down" BACT analysis for NO_x has been prepared in accordance with EPA's 1990 Draft New Source Review Workshop Manual. A "top-down" BACT analysis takes into account energy, environmental, economic, and other costs associated with each alternative technology.

8.1E.1.1 Identify All Control Technologies

The baseline NOx emission rate for this analysis is considered to be 75 ppmvd @ 15% O_2, based on the governing new source performance standard (40 CFR 60 Subpart GG). This emission rate provides the frame of reference for the evaluation of control effectiveness and feasibility. The maximum degree of control, resulting in the minimum emission rate, is a combination of water injection and either selective catalytic reduction or SCONOx to achieve a long-term NOx limit of approximately 2.0 ppmvd. Several intermediate levels of control are also evaluated.

There are three basic means of controlling NOx emissions from combustion turbines: wet combustion controls, dry combustion controls, and post-combustion controls. Wet and dry combustion controls act to reduce the formation of NOx during the combustion process, while post-combustion controls remove NOx from the exhaust stream. Potential NOx control technologies for combustion gas turbines include the following:

Wet combustion controls

  Water injection

  Steam injection

Dry combustion controls

  Dry low-NOx combustor design

  Catalytic combustors (e.g., XONON)

  Other combustion modifications

Post-combustion controls

  Selective non-catalytic reduction (SNCR)

Non-selective catalytic reduction (NSCR)

  Selective catalytic reduction (SCR)

  SCONOx

8.1E.1.2 Eliminate Technically Infeasible Options

The performance and technical feasibility of available NOx control technologies are discussed in more detail below.

Combustion Modifications

Wet Combustion Controls

Steam or water injection directly into the turbine combustor is one of the most common NOx control techniques for combustion turbines. These wet injection techniques lower the flame temperature in the combustor and thereby reduce thermal NOx formation. The water or steam-to-fuel injection ratio is the most significant factor affecting the performance of wet controls. Steam injection techniques can reduce NOx emissions in gas-fired turbines to between 15 and 25 ppmv at 15% O_2; the practical limit of water injection has been demonstrated at approximately 25-42 ppmv @ 15% O_2 before combustor damage becomes significant. Higher diluent:fuel ratios (especially with steam) not only result in greater NOx reductions, but also increase emissions of CO and hydrocarbons, reduce turbine efficiency, and may increase turbine maintenance requirements. The principal NOx control mechanisms are identical for water and steam injection. Water or steam is injected into the primary combustion chamber to act as a heat sink, lowering the peak flame temperature of combustion and thus lowering the quantity of thermal NOx formed. The injected water or steam exits the turbine as part of the exhaust.

Because water has a higher heat absorbing capacity than steam (due to the temperature and to the latent heat of vaporization associated with water), it takes more steam than water to achieve an equivalent level of NOx control. Typical steam injection ratios are 0.5 to 2.0 pounds steam per pound fuel; water injection ratios are generally below 1.0 pound water per pound fuel.

Although the lower peak flame temperature has a beneficial effect on NOx emissions, it can also reduce combustion efficiency and prevent complete combustion. As a result, CO and VOC emissions increase as water/steam-to-fuel ratios increase. Thus, the higher steam-to-fuel ratio required for NOx control will tend to cause higher CO and VOC emissions from steam-injected turbines than from water-injected turbines, due to the kinetic effect of the water molecules interfering with the combustion process. However, steam injection can reduce the heat rate of the turbine so that equivalent power output can be achieved with reduced fuel consumption and reduced SO_2 emission rates.

Water and steam injection have been in use on both oil- and gas-fired combustion turbines in all size ranges for many years, so these NOx control technologies are clearly technologically feasible and widely available.

Dry Combustion Controls

Combustion modifications that lower NOx emissions without wet injection include lean combustion, reduced combustor residence time, lean premixed combustion, and two-stage rich/lean combustion. Lean combustion uses excess air (greater than stoichiometric air-to-fuel ratio) in the combustor primary combustion zone to cool the flame, thereby reducing the rate of thermal NOx formation. Reduced combustor residence times are achieved by introducing dilution air between the combustor and the turbine sooner than with standard combustors. The combustion gases are at high temperatures for a shorter time, which also has the effect of reducing the rate of thermal NOx formation.

The most advanced combination of combustion controls for NOx is referred to as dry low-NOx (DLN) combustors. DLN technology uses lean, premixed combustion to keep peak combustion temperatures low, thus reducing the formation of thermal NOx. This technology is effective in achieving NOx emission levels comparable to levels achieved using wet injection without the need for large volumes of purified water and without the increases in CO and VOC emissions that result from wet injection. However, this control technology does not result in lower NOx emissions than can be achieved using water injection on the LM6000 combustion turbine.

Catalytic combustors use a catalytic reactor bed mounted within the combustor to burn a very lean fuel-air mixture. This technology has been commercially demonstrated under the trade name XONON in a 1.5 MW natural gas-fired combustion turbine in Santa Clara, California. The technology has also been announced as commercially available for some models of small combustion turbines, generally 10 MW in size and less. The technology has not been announced commercially for the engines used at the SFPERP. No turbine vendor, other than General Electric, has indicated the commercial availability of catalytic combustion systems at the present time; therefore, catalytic combustion controls are not available for this specific application and are not discussed further.

Post-Combustion Controls

SCR is a post-combustion technique that controls both thermal and fuel NOx emissions by reducing NOx with a reagent (generally ammonia or urea) in the presence of a catalyst to form water and nitrogen. NOx conversion is sensitive to exhaust gas temperature, and performance can be limited by contaminants in the exhaust gas that may mask the catalyst (sulfur compounds, particulates, heavy metals, and silica). SCR is used in numerous gas turbine installations throughout the United States, almost exclusively in conjunction with other wet or dry NOx combustion controls. SCR requires the consumption of a reagent (ammonia or urea) and requires periodic catalyst replacement. Estimated levels of NOx control are in excess of 90%.

Selective non-catalytic reduction (SNCR) involves injection of ammonia or urea with proprietary conditioners into the exhaust gas stream without a catalyst. SNCR technology requires gas temperatures in the range of 1200° to 2000° F and is most commonly used in boilers. The exhaust temperatures for the SFERP gas turbines are in the 800° F range, which is well below the minimum SNCR operating temperature. Some method of exhaust gas reheat, such as additional fuel combustion, would be required to achieve exhaust temperatures compatible with SNCR operations, and this requirement makes SNCR technologically infeasible for this application. Even when technically feasible, SNCR is unlikely to achieve NOx reductions in excess of 80%-85%.

Nonselective catalytic reduction (NSCR) uses a catalyst without injected reagents to reduce NOx emissions in an exhaust gas stream. NSCR is typically used in automobile exhaust and rich-burn stationary IC engines, and employs a platinum/rhodium catalyst. NSCR is effective only in a stoichiometric or fuel-rich environment where the combustion gas is nearly depleted of oxygen, and this condition does not occur in turbine exhaust where the oxygen concentrations are typically between 14 and 16%. For this reason, NSCR is not technologically feasible for this application.

SCONOx is a proprietary catalytic oxidation and adsorption technology that uses a single catalyst for the control of NOx, CO, and VOC emissions. The catalyst is a monolithic design, made from a ceramic substrate with both a proprietary platinum-based oxidation catalyst and a potassium carbonate adsorption coating. The catalyst simultaneously oxidizes NO to NO_2, CO to CO_2, and VOCs to CO_2 and water, while NO_2 is adsorbed onto the catalyst surface where it is chemically converted to and stored as potassium nitrates and nitrites. The SCONOx potassium carbonate layer has a limited adsorption capability and requires regeneration approximately every 12-15 minutes in normal service.[2] Each regeneration cycle requires approximately 3-5 minutes. At any point in time, approximately 20% of the compartments in a SCONOx system would be in regeneration mode, and the remaining 80% of the compartments would be in oxidation/absorption mode.[3]

Regeneration of the adsorption layer requires exposure of the catalyst to hydrogen gas. In practice, this is accomplished by reforming natural gas with high-pressure steam to produce a gas mixture consisting of methane, carbon dioxide, and hydrogen that is passed over the catalyst beds.[4] Initial attempts by the developer of the process to create regeneration gases from natural gas and steam within the SCONOx catalyst bed (internal autothermal regeneration) failed to produce consistent results; this approach was abandoned in favor of the current offering, which uses an external steam-heated reformer that partially reforms the natural gas to produce the gas mixture that is introduced into the catalyst bed.[5] The reformation reaction continues to some extent within the catalyst bed due to the presence of steam and the temperature of the catalyst surface, but some methane and VOCs from the natural gas remain.

Because the active regenerant gas is hydrogen, the regeneration process must be performed in an atmosphere of low oxygen to prevent dilution of the hydrogen. In practice, the oxygen present in the exhaust gas of combustion turbines is excluded from the catalyst bed by dividing the catalyst bed into a number of individual cells or compartments that are equipped with front and rear dampers that are closed at the beginning of each regeneration cycle. Proper regeneration of the SCONOx catalyst system depends upon the proper functioning and sealing of these sets of dampers approximately 4 times per hour so that an adequate concentration of hydrogen can be maintained in each module to accomplish complete regeneration of the catalyst before the dampers are opened and the compartment is placed back in service.

Because the SCONOx catalyst can be "poisoned" or rendered inactive by even the very small amounts of sulfur compounds present in natural gas, a SCOSOx catalyst bed (or "guard bed") that is intended to remove trace quantities of sulfur-bearing compounds from the exhaust gas stream is installed upstream of the SCONOx catalyst bed. Like the SCONOx catalyst, the SCOSOx catalyst must be regenerated. Regeneration of the two catalyst types occurs at the same time, with the same regeneration gas supply provided to both; however, the sulfur-bearing regeneration gases for the SCOSOx catalyst exit the SCONOx modules separately from the SCONOx regeneration gases to avoid contaminating the SCONOx catalyst beds. Both regeneration gas streams are returned to the gas turbine exhaust stream downstream of the SCONOx module.[6]

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[2] Personal communication, ABB Environmental, 1/18/00.

[3] Stone & Webster, "Independent Technical Review – SCONOx Technology and Design Review", February 2000.

[4] Stone & Webster, op cit

[5] ABB Environmental, op cit

[6] ABB Environmental, op cit

The external reformer used to create the regeneration gases is supplied with steam and natural gas. For one F-class turbine, an estimated 15,000 to 20,000 lbs/hr of 600°F steam is required, along with approximately 100 pounds per hour (2.2 MMbtu/hr) of natural gas.[7] These quantities would be expected to be lower for the smaller LM6000 combustion turbines used in this project. To avoid poisoning the reformer catalyst, the natural gas supplied to the reformer passes through an activated carbon filter to remove some of the sulfur-bearing compounds that are added to natural gas to facilitate leak detection.[8]

The regeneration cycle time is expected to be controlled using a feedback system based on NOx emission rates.[9] That is, the higher the NOx emissions are relative to the design level, the shorter the absorption cycle, and regeneration cycles will occur more frequently. This is analogous to the use of feedback systems for controlling reagent (ammonia or urea) flow rates in an SCR system.

Maintenance requirements for SCONOx systems are expected to include periodic replacement of the reformer fuel sulfur carbon unit, periodic replacement of the reformer catalyst, periodic washings of the SCOSOx and SCONOx catalyst beds, and periodic replacement of the SCOSOx and SCONOx catalyst beds. The replacement frequency for the reformer sulfur carbon unit and reformer catalyst is unknown to the applicant at present. The SCOSOx catalyst is expected to require washing several times per year. The lead (upstream) SCONOx catalyst bed is also expected to require washing several times per year, while the trailing (downstream) SCONOx catalyst bed(s) are expected to require washing less frequently. The annual catalyst washing process is expected to take approximately three days for an F-class machine, at an estimated annual cost of $200,000.[10] For the smaller LM6000 CTG, the time requirement and cost can be estimated to be approximately one-third of this, or one day and $65,000. The estimated catalyst life is reported to be 7 washings;[11] the guaranteed catalyst life is 3 years.[12]

The adsorption temperature operating range for the SCONOx system is 300°F to 700°F, with an optimal temperature of approximately 600°F.[13] However, regeneration cycles are not initiated unless the catalyst bed temperature is above 450°F to avoid the creation of hydrogen sulfide during the regeneration of the SCOSOx catalyst.[14]

Estimates of control system efficiency vary. ABB Environmental has indicated that the SCONOx system is capable of achieving a 90% reduction in NOx; a 90% reduction in CO, to a level of 2 ppm; and an 80%-85% reduction in VOC emissions.[15] (This VOC reduction is not likely to be achieved with low VOC inlet concentrations, in the 1–2 ppm range.[16]) Commercially quoted NOx emission rates for the SCONOx system range from 2.0 ppm on a 3-hour average basis, representing a 78% reduction,[17] to 1.0 ppm with no averaging period specified (96% reduction).[18] The SCONOx system does not control or reduce emissions of sulfur oxides or particulate matter from the combustion device.[19]

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[7] Ibid

[8] Stone & Webster, op cit

[9] Ibid

[10] Ibid

[11] Ibid

[12] Letter from ABB Alstom Power to Bibb & Associates dated May 5, 2000. (ABB Three Mountain Power or ABB TMP)

[13] Ibid

[14] ABB Environmental, op cit. Stone & Webster, op cit

[15] ABB Environmental, op cit

[16] Ibid

[17] ABB TMP, op cit

The SCONOx system has been applied at the Sunlaw Federal Cogeneration Plant in Vernon California since December 1996, and at the Genetics Institute Facility in Massachusetts. The Sunlaw facility uses an LM-2500 gas turbine, rated at a nominal 23 MW, and the Genetics Institute facility has a 5 MW Solar gas turbine.

The SCONOx system was proposed for use by PG&E Generating Company at its La Paloma facility; however, PG&E Generating no longer plans to use the SCONOx system at that site.[20] The SCONOx system was also proposed for demonstration by PG&E Generating Company at the Otay Mesa Generating Project; however, PG&E Generating Company sold the project to Calpine and Calpine has indicated that it no longer plans to use SCONOx. Although the technology's co-developer, Sunlaw, proposed to use the technology in conjunction with ABB gas turbines at the Nueva Azalea site in Southern California, the Nueva Azalea project has been withdrawn from the CEC licensing process.

The University of California, San Diego, operates two SoLoNox Titan 130S combustion turbines that are equipped with SCONOx. Each CTG is rated at approximately 13 MW and has NOx and CO emissions limits of 2.5 and 5.0 ppmvd @ 15% O_2, 3-hour average, respectively. Quarterly emission reports for the first 3 quarters of 2002 showed that Unit 1 had 5219 hours of operation with 9 3-hour periods of excess emissions, while Unit 2 had 5294 hours of operation with no exceedances of the 2.5 ppm NOx limit. In 2002, the SCONOx catalyst had to be washed three times, with the units taken off-line each time.

Redding Electric Utility operates a 43 MW Alstom Power Model GTX 100 CTG that is equipped with SCONOx at its Redding power plant. The unit has NOx and CO limits of 2.5 and 6.0 ppmvd @ 15% O_2, one-hour average basis, respectively, with a "demonstration" NOx limit of 2.0 ppm. Despite initial compliance problems, the turbine is currently operating in compliance with the 2.5 ppm NOx limit, but the operator is having to wash the catalyst more often than expected. The unit has not been able to consistently meet the 2.0 ppm "demonstration" limit.

The following information is taken from the ARB's draft report to the legislature, titled "Gas-Fired Power Plant NOx Emission Controls and Related Environmental Impacts," May 2004.

> University of California San Diego
>
> The system at the University of California San Diego has been in operation since July 2001. This installation operates at 420 F to treat the exhaust gases from two Solar SoLoNOx Titan 130S gas turbines (26 MW) at a cogeneration plant. Initially, the facility was under a variance with the San Diego County Air Pollution Control District—the turbines passed the start-up source test, but failed their Relative Accuracy Test Audit (RATA).[21] The facility installed a multi-point probe and

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[18] Letter from ABB Alstom Power to Sunlaw Energy Corporation dated February 11, 2000. (ABB Sunlaw)

[19] ABB Environmental, op cit

[20] Ibid

[21] The RATA is essentially an on-site analyzer comparison test between the CEMS analyzers and those used by a RATA testing company. Both systems sample the same source and the results are subjected to

subsequently passed the test. The plant operator reports that the permit limits are being met, but that maintenance is more extensive than originally estimated. Quarterly CEMS reports from October 2002 through September 2003 indicate no excess NOx emissions. The plant operator reports NOx measurements meet the 2.5 ppmvd at 15% O_2 permit limit between catalyst washings, which are currently conducted about every four months. During the wash process, the plant is down for about three days. The facility has determined that emission levels are best met when all three layers of catalyst are washed, not just the leading layer. Overall, the facility is pleased with the emissions performance, and they attribute the more frequent washing to the engineering design of the regeneration system (e.g., gas leaks and inefficiencies in regenerating sulfur from the SCOSOx guard bed). Based on experience from this site, EmeraChem has improved the regeneration system design.

City of Redding

The system at the City of Redding Power Plant in Redding, California, has been in operation since June 2002 and has accumulated approximately 8,300 hours of run time. This installation operates at 600 F to treat the exhaust gases from an Alstom Power GTX 100 gas turbine (43 MW) at a combined-cycle plant. Redding Power owns the dampers but has a 15-year lease agreement on the catalyst from Alstom. As such, Alstom is in charge of ongoing catalyst maintenance. The Shasta County Air Quality Management District reports that there have been no major compliance issues in meeting the 2.5 ppmvd at 15% O_2 NOx permit limit. To date, the SCONOx catalyst has required washing about three times per year, and the SCOSOx catalyst has not yet required washing. The wash process is generally completed over a weekend. The SCONOx reactor contains three layers of SCONOx catalyst. Since installation, the leading layer of SCONOx catalyst has been replaced—the second and third layers are the originals.

As discussed further below, there are serious questions about the probability of a successful commercial demonstration and the commercial availability of the technology for application to the SFERP, as well as the levels of emission control that can be consistently achieved. However, based on the preceding discussion, the SCONOx system will be considered as technologically feasible for the purposes of this analysis.

Based on the discussions above, the following NOx control technologies are available and potentially technologically feasible for the proposed project:

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statistical analysis and compared. The average accuracy of the CEMS analyzer relative to the RATA analyzer must be within a specific percentage.

- Water injection
- Selective Catalytic Reduction
- SCONOx

8.1E.1.3 Rank Remaining Control Technologies by Control Effectiveness

The remaining technically feasible control technologies are ranked by NOx control effectiveness in Table 8.1-E-1.

TABLE 8.1E-1
NOx Control Alternatives

NOx Control Alternative	Available?	Technically Feasible?	NOx Emissions (@ 15% O_2)	Environmental Impact	Energy Impacts
Water Injection	Yes	Yes	25 ppm	Increased CO/VOC	Decreased Efficiency
Steam Injection	No	No	15 – 25 ppm	Increased CO/VOC	Increased Efficiency
Dry Low-NOx Combustors	No	No	9-25 ppm	Reduced CO/VOC	Increased Efficiency
Selective Catalytic Reduction	Yes	Yes	>90% reduction 1 – 2.5 ppm	Ammonia slip	Decreased Efficiency
SCONOx	Yes[a]	Yes	>90% reduction 1 – 2.5 ppm	Reduced CO; potential reduction in VOC	Decreased Efficiency

a. There are no standard, commercial guarantees for LM6000 projects for this technology available in the public domain.

8.1E.1.4 Available Control Options and Technical Feasibility

In a March 24, 2000 letter sent to local air pollution control districts, EPA Region 9 stated that the SCONOx Catalytic Adsorption System should be included in any BACT/LAER analysis for combined cycle combustion turbine power plant projects since it can achieve the BACT/LAER emission specification for NO_x of 2.5 ppmvd @ 15% O_2, averaged over one hour or 2.0 ppmvd @ 15% O_2, averaged over three hours. In this letter, EPA stated that ABB Alstom Power, the exclusive licensee for SCONOx applications, has conducted "full-scale damper testing" that demonstrates that SCONOx is technically feasible for utility-scale combustion turbines. Stone & Webster Management Consultants, Inc. of Denver, Colorado was subsequently hired by ABB to conduct an independent technical review of the SCONOx technology as well as the full-scale damper testing program. According to the report by Stone & Webster, modifications to the actuators, fiberglass seals, and louver shaft-seal interface are being incorporated to resolve unacceptable reliability and leakage problems. However, no subsequent testing of the redesigned components has occurred to determine if the problems have been solved. Because the feasibility of the "scale-up" of the SCONOx system for large turbines has not been demonstrated, SCONOx is not considered to be a demonstrated NO_x control technology for projects of the size of the SFERP. Further, the SFERP consists of simple-cycle and not combined-cycle combustion turbines.

Although SCONOx is not considered to be a demonstrated control alternative for this project, it may be considered a technically feasible technology, and thus we have analyzed the collateral impacts of both SCR and SCONOx. Because SCONOx does not offer any emission control benefits over SCR control technology, the following analysis compares the cost-effectiveness and collateral impacts of the two technologies. The analysis shown in Table 8.1E-2 applies to three GE LM6000 combustion turbines equipped with water injection and an uncontrolled NO_x emission rate of 25 ppmvd @ 15% O_2. Details of the calculations are shown in Figures 8.1E-1 and 8.1E-2.

TABLE 8.1E-2
Top-Down BACT Analysis Summary for NOx

Control Technology	Controlled Emissions, tpy[a]	Emissions Controlled, tpy[b]	Average Cost-Effectiveness, $/ton[c]	Electricity Cost Impact, $/kwh[d]	Collateral Toxic Impacts?	Incremental Energy Impact, MMBtu/yr[e]
SCONOx	39.8	224.7	$18,671	0.981	No	109,818
SCR	39.8	224.7	$7,253	0.381	No	61,119

a. From Table 8.1A-5, based on 2.5 ppmvd controlled emission rate. Total, three turbines.
b. Based on 25 ppmvd uncontrolled emission rate from turbines, 90% control. Total, three turbines.
c. Total annual costs from ONSITE SYCOM Energy Corporation report for US DOE: "Cost Analysis of NOx Control Alternatives for Stationary Gas Turbines, Contract No. DE-FC02-97CHIO877," October 15, 1999. Scaled for 47.5 MW LM6000 turbine from data in Tables A-5 and A-7.
d. Electricity cost from Ref c.
e. "Towantic Energy Project Revised BACT Analysis", RW Beck, February 18, 2000; based upon increased fuel use required to overcome catalyst bed back pressure. Scaled by ratio of Frame 7FA unit to LM6000 unit, or 161 MW/47.5 MW.

Energy Impacts

As shown in Table 8.1E-2, the use of SCR does not result in any significant or unusual energy penalties or benefits when compared to SCONOx. Although the operation and maintenance of SCONOx does result in a greater energy penalty when compared to that of SCR, this is not considered significant enough to eliminate SCONOx as a control alternative.

Economic Impacts

According to EPA's 1990 Draft New Source Review Workshop Manual, "Average and incremental cost effectiveness are the two economic criteria that are considered in the BACT analysis."

As shown in Table 8.1E-2, the average cost-effectiveness of both SCR and SCONOx meet the current District cost-effectiveness guideline of $17,500 per ton of NO_x abated. However, the average cost-effectiveness of SCR is approximately 40% of the average cost-effectiveness of SCONOx. These figures are based on total annualized cost figures from a cost analysis conducted by ONSITE SYCOM Energy Corporation.[22] Although SCONOx will result in greater economic impact as quantified by average cost effectiveness, this impact is not considered adverse enough to eliminate SCONOx as a control alternative. Incremental cost-effectiveness does not apply since SCR and SCONOx both achieve the BACT standard for NO_x of 2.5 ppmvd @ 15% O_2, averaged over three hours, and therefore achieve the same NO_x emission reduction in tons per year.

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[22] ONSITE SYCOM Energy Corporation for US DOE: "Cost Analysis of NOx Control Alternatives for Stationary Gas Turbines," Contract No. DE-FC02-97CHIO877, October 15, 1999.

Environmental Impacts

The use of SCR will result in ammonia emissions due to an allowable ammonia slip limit of 10 ppmvd @ 15% O_2. A health risk screening analysis of the proposed project using air dispersion modeling showed an acute hazard index and a chronic hazard index to be each much less than 1, resulting from an ammonia slip limit of 10 ppmv @ 15% O_2. In accordance with the District Toxic Risk Management Policy and currently accepted practice, a hazard index of less than 1.0 or above is considered not significant. Therefore, the toxic impact of the ammonia slip resulting from the use of SCR is deemed to be not significant and is not a sufficient reason to eliminate SCR as a control alternative.

The ammonia emissions resulting from the use of SCR may have another environmental impact through their potential to form secondary particulate matter such as ammonium nitrate. Because of the complex nature of the chemical reactions and dynamics involved in the formation of secondary particulates, it is difficult to estimate the amount of secondary particulate matter that will be formed from the emission of a given amount of ammonia. However, the Research and Modeling section of the BAAQMD Planning Division has stated in previous CEC proceedings that the formation of ammonium nitrate in the Bay Area air basin is limited by the formation of nitric acid and not driven by the amount of ammonia in the atmosphere. Therefore, ammonia emissions from the proposed SCR system are not expected to contribute significantly to the formation of secondary particulate matter within the BAAQMD.

A second potential environmental impact that may result from the use of SCR involves the storage and transport of aqueous ammonia. Although ammonia is toxic if swallowed or inhaled and can irritate or burn the skin, eyes, nose, or throat, it is a commonly used material that is typically handled safely and without incident. The SFERP will be required to maintain a Risk Management Plan (RMP) and implement a Risk Management Program to prevent accidental releases (see Section 8.5 of the AFC). The RMP will provide information on the hazards of the substance handled at the facility and the programs in place to prevent and respond to accidental releases. The accident prevention and emergency response requirements reflect existing safety regulations and sound industry safety codes and standards. In addition, the modeling analysis of the health impacts arising from a catastrophic release of ammonia due to spontaneous storage tank failure at the SFERP shows that the impact would not be significant. Thus the potential environmental impact due to aqueous ammonia storage at the SFERP does not justify the elimination of SCR as a control alternative.

Conclusion

Because both SCR and SCONOx can achieve the proposed BACT NOx emission limit of 2.5 ppmvd @ 15% O_2 averaged over three hours and neither will cause significant energy, economic, or environmental impacts, neither can be eliminated as viable control alternatives. The concern remains regarding the long-term effectiveness of SCONOx as a control technology as the technology has not been demonstrated on the turbines used in this project. For this reason, SCR has been selected as the NOx control technology to be used for the the SFERP.

8.1E.2 Determination of BACT Emission Rates

The BACT analysis performed for NOx control includes the following:

- Review of published BACT guidelines for natural gas-fired simple cycle gas turbines;
- Review of recent BACT decisions for natural gas-fired simple-cycle gas turbines;
- Review of continuous NOx emissions monitoring data for natural gas-fired simple-cycle gas turbines obtained from EPA's acid rain website;
- Review of federal NSPS for natural gas-fired simple cycle gas turbines; and
- Review of published prohibitory rules for natural gas-fired simple cycle gas turbines.

Published BACT Guidelines

Published BACT determinations from the following agencies were reviewed to identify relevant previously established BACT guidelines:

- California Air Resources Board (ARB);
- Bay Area Air Quality Management District (BAAQMD);
- San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD); and
- South Coast Air Quality Management District (SCAQMD).

ARB's BACT Clearinghouse contained determinations by the Sacramento Metropolitan Air Quality Management District (SMAQMD) that specified water injection and SCR achieving an emission limit of 5 ppmv @ 15% O_2 as BACT for the following facilities:

- Carson Energy Group cogeneration plant in Sacramento, California; and
- Sacramento Cogeneration Authority cogeneration plant in Sacramento, California.

This clearinghouse has not been updated since 2000. ARB is also in the process of developing a new guideline document for power plant permitting. The most recent available ARB document on this subject[23] indicated that BACT for NOx from gas turbines without heat recovery systems rated at < 50 MW was still 5 ppmv @ 15% O_2 on a 3-hour average basis.

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[23] ARB Guidance for the Permitting of Electrical Generation Technologies, July 2002.

The BAAQMD's BACT guidelines specify that, for natural gas-fired simple cycle combustion gas turbines, a NOx limit of 5 ppmv @ 15% O_2 has been "achieved in practice." This BACT guideline was established in CARB's Guidance for Power Plant Sitting and Best Available Control Technology (June 1999).

The SJVUAPCD's BACT guidelines contained a determination for gas turbines rated at less than 50 MW with uniform load and without heat recovery. The SJVUAPCD concluded that a NOx exhaust concentration of 5 ppmv @ 15% O_2 constituted BACT that had been achieved in practice and 3 ppmv @ 15% O_2 constituted BACT that is technologically feasible.

Recent BACT Decisions

The ARB staff has prepared a draft table summarizing NOx emission control requirements and permitted emission levels for simple-cycle power plant gas turbines. This table showed that most of the recently permitted simple-cycle gas turbine projects in California have been required to meet NOx BACT limits of 2.5 to 3 ppmvd @ 15% O_2 on a 3-hour average basis. The most recent of these BACT determinations was made by the SJVUAPCD for the Modesto Irrigation District MEGS project, which also consists of GE LM6000 Sprint gas turbines equipped with water injection and SCR for NOx control. For this project, which has been approved by the District and was licensed by the CEC on February 4, 2004, NOx BACT was determined to be 2.5 ppmvd @ 15% O_2 on a 3-hour average basis.

This table also shows that in 2001, the Massachusetts Department of Environmental Protection issued two permits for GE LM6000 simple-cycle gas turbines with NOx emissions limitations of 2.0 ppmvd @ 15% O_2 on a 1-hour average basis. Only one of these facilities is currently in operation and reporting emissions data to EPA, and as discussed below, the operating facility has not been able to meet this limit in operation. The NOx limit has been changed to 3.5 ppmvd @ 15% O_2, which is higher than the level considered to be BACT in California.

The SCAQMD database included a December 2001 determination for the Wildflower Energy Indigo power plant that BACT for NOx for a simple-cycle LM5000 Sprint gas turbine was 5 ppm on a 1-hour average basis.

Review of NOx CEMS Data

Real-time hourly NOx CEMS data are available on EPA's Acid Rain website for generating units that are subject to acid rain reporting requirements. The reported NOx data for the West Springfield Redevelopment Project simple-cycle gas turbines were analyzed for compliance with the original permit limit of 2.0 ppmvd @ 15% O_2, 1-hour average basis. Five quarters of monitoring data were available for each of the two West Springfield Redevelopment Project units. Analysis of these data showed that when low-load, startup/shutdown and commissioning periods were excluded, the turbines operated in compliance with the 2.0 ppm, 1-hour average permit limit only between 10 and 20% of the time (see Table 8.1E-3). Even a 3.0 ppm, 3-hour average limit would have been exceeded almost 10% of the time. The NOx limit for these turbines was recently revised to 3.5 ppmvd @ 15% O_2.

Federal NSPS

The NSPS applicable to new natural gas-fired combustion gas turbines are found in Title 40 CFR Part 60 Subpart GG. As discussed in Section 8.1.4.2.2 of the application, the NOx emission limit applicable to the proposed combustion gas turbines will be 109 ppmv @ 15% O_2.

Table 8.1E-3
Summary of NOx Emissions Performance: West Springfield Redevelopment Project LM6000 Simple Cycle Gas Turbines

Unit/Period	Averaging Prd	Exceedance Frequency Based on NOx Limit, ppmvd @ 15% O_2 3.0	2.5	2.0
Unit 1				
5/1 to 12/31/2002	1 hour	14%	43%	84%
	3 hours	11%	37%	82%
1/1 to 6/30/2003	1 hour	20%	34%	98%
	3 hours	13%	27%	99%
Unit 2				
5/1 to 12/31/2002	1 hour	11%	53%	79%
	3 hours	9%	56%	77%
1/1 to 6/30/2003	1 hour	7%	16%	90%
	3 hours	5%	18%	91%

District Prohibitory Rules

Published prohibitory rules from the BAAQMD, SMAQMD, San Diego County Air Pollution Control District (SDCAPCD), SJVUAPCD, and SCAQMD were reviewed to identify the NOx standards that govern existing natural gas-fired simple cycle combustion gas turbines.

- BAAQMD adopted Rule 9-9 (Nitrogen Oxides from Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 9-9 specifies an efficiency-adjusted NOx emission limit of 13.0 ppmv @ 15% O_2 for natural gas-fired combustion gas turbines rated at no less than 10 MW, rated at 9,353 Btu/kW-hr (HHV), and equipped with SCR.

- The SMAQMD adopted Rule 413 (Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 413 specifies a NOx emission limit of 9 ppmv @ 15% O_2 for natural gas-fired combustion gas turbines rated at no less than 10 MW and equipped with SCR.

- The SJVUAPCD adopted Rule 4703 (Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 4703 specifies an enhanced Tier II NOx emission limit of 3 ppmv @ 15% O_2 for natural gas-fired combustion gas turbines rated at no less than 10 MW and equipped with SCR (April 30, 2008 deadline).

- The SCAQMD adopted Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 1134 specifies an efficiency-adjusted NOx emission limit of 13 ppmv @ 15% O_2 for natural gas-fired combustion gas turbines rated no less than 10 MW, rated at 9,353 Btu/kW-hr, and equipped with SCR.

Conclusions

BACT must be at least as stringent as the most stringent level achieved in practice, federal NSPS, or district prohibitory rule. Based upon the results of this analysis, the NOx BACT determination of 2.5 ppm @ 15% O_2 on a 3-hour average basis made for recently permitted simple cycle turbine projects in the Bay Area and the SJVUAPCD reflects the most stringent achievable NOx emission limit. Therefore, BACT for NOx emissions for natural gas-fired simple cycle combustion gas turbines is 2.5 ppmv @ 15% O_2. The SFERP facility will be designed to meet a NOx level of 2.5 ppmv @ 15% O_2 on a 3-hour average basis.

Carbon Monoxide

The BACT analysis performed for CO control includes the following:

- Review of published BACT guidelines for natural gas-fired simple cycle combustion gas turbines;
- Review of recent BACT decisions for natural gas-fired simple-cycle gas turbines;
- Review of federal NSPS for natural gas-fired simple cycle combustion gas turbines; and
- Review of published prohibitory rules for natural gas-fired simple cycle combustion gas turbines.

Published BACT Guidelines

As discussed in the previous section, published BACT determinations from the following agencies were reviewed to identify any previously established BACT guidelines:

- ARB;
- BAAQMD;
- SJVUAPCD; and
- SCAQMD.

The ARB's BACT guidance document for electric generating units rated at less than 50 MW[24] indicates that BACT for the control of CO emissions from stationary gas turbines rated at less than 50 MW used in electrical generation is 6 ppmvd @ 15% O_2.

The BAAQMD's BACT guidelines specify that, for natural gas-fired simple cycle combustion gas turbines, a CO limit of 6 ppmv @ 15% O_2 has been "achieved in practice." A BACT guideline of 6 ppmv @ 15% O_2 was established in CARB's Guidance for Power Plant Sitting and Best Available Control Technology (June 1999).

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[24] Ibid, Table I-1.

The SJVUAPCD's BACT guidelines contained a determination for gas turbines rated at less than 50 MW with uniform load and without heat recovery. The SJVUAPCD concluded that a CO exhaust concentration of 6 ppmv @ 15% O_2 constituted BACT that had been achieved in practice.

The SCAQMD database did not contain BACT guidelines for VOC emissions from natural gas-fired simple cycle combustion gas turbines.

Recent BACT Decisions

The ARB staff has prepared a draft table of NOx emission control requirements and permitted emission levels for simple-cycle power plant gas turbines. This table, which includes information regarding limits for VOC, CO, PM_{10}, SO_2 and ammonia, shows that most of the recently permitted simple-cycle gas turbine projects in California have been required to meet CO BACT limits of 6 ppmvd @ 15% O_2 on a 1-hour average basis. The most recent of these BACT determinations was made by the SJVUAPCD for the Modesto Irrigation District Ripon project, which also consists of GE LM6000 Sprint gas turbines equipped with water injection and SCR for NOx control. For this project, which has been approved by the District and is expected to be licensed by the CEC before the end of 2003, CO BACT was determined to be 6 ppmvd @ 15% O_2 on a 3-hour average basis.

The SCAQMD database included a December 2001 determination for the Wildflower Energy Indigo power plant that BACT for CO for a simple-cycle LM5000 Sprint gas turbine was 6 ppm on a 1-hour average basis.

Federal NSPS

The NSPS applicable to new natural gas-fired combustion gas turbines are found in Title 40 CFR Part 60 Subpart GG. This NSPS does not specify an emission limit for CO.

District Prohibitory Rules

Published prohibitory rules from the BAAQMD, SMAQMD, SDCAPCD, SJVUAPCD, and SCAQMD were reviewed to identify the CO standards that govern existing natural gas-fired simple cycle combustion gas turbines. Of the five prohibitory rules reviewed, the SJVUAPCD prohibitory rule for combustion gas turbines is the only one that includes an emission limit for CO (200 ppmv @ 15% O_2). Generic prohibitory rules (i.e., not device specific) from each of these districts were also reviewed; emission limits are 2000 ppmv at actual operating conditions.

Conclusions

BACT must be at least as stringent as the most stringent level required in a permit, federal NSPS, or district prohibitory rule. Based upon the results of this analysis, the BAAQMD BACT determination for natural gas-fired simple cycle combustion gas turbines, obtained from CARB's Guidance for Power Plant Sitting and Best Available Control Technology, reflects the most stringent CO emission limit. Therefore, BACT for CO emissions from natural gas-fired simple cycle combustion gas turbines is 6 ppmv @ 15% O_2. The proposed CO emission limit of 4 ppmvd @ 15% O_2 on a 3-hour average basis is more stringent than the level currently considered BACT, but is expected to be achievable in practice.

Volatile Organic Compounds

The BACT analysis performed for VOC control includes the following:

- Review of published BACT guidelines for natural gas-fired simple cycle combustion gas turbines;
- Review of recent BACT decisions for natural gas-fired simple-cycle gas turbines;
- Review of federal NSPS for natural gas-fired simple cycle combustion gas turbines; and
- Review of published prohibitory rules for natural gas-fired simple cycle combustion gas turbines.

Published BACT Guidelines

As discussed previously, published BACT determinations from the following agencies were reviewed to identify any previously established BACT guidelines:

- ARB;
- BAAQMD;
- SJVUAPCD; and
- SCAQMD.

The ARB's BACT guidance document for electric generating units rated at less than 50 MW[25] indicates that BACT for the control of POC emissions from stationary gas turbines rated at less than 50 MW used in electrical generation is 2 ppmvd @ 15% O_2.

ARB's BACT Clearinghouse contained SMAQMD determinations that specified an oxidation catalyst achieving an emission limit of 2.1 ppmv @ 15% O_2 as BACT for the following facilities:

- Carson Energy Group cogeneration plant in Sacramento, California; and
- Sacramento Cogeneration Authority cogeneration plant in Sacramento, California.

The BAAQMD's BACT guidelines specify that, for natural gas-fired simple cycle combustion gas turbines, a VOC limit of 2 ppmv @ 15% O_2 has been "achieved in practice." This BACT guideline was established in CARB's Guidance for Power Plant Sitting and Best Available Control Technology (June 1999).

The SJVUAPCD's BACT guidelines contained a determination for gas turbines rated at less than 50 MW with uniform load and without heat recovery. The SJVUAPCD concluded that a VOC exhaust concentration of 2.0 ppmv @ 15% O_2 constituted BACT that had been achieved in practice.

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[25] Ibid, Table I-1.

The SCAQMD database did not contain BACT guidelines for VOC emissions from natural gas-fired simple cycle combustion gas turbines.

Recent BACT Decisions

The ARB staff has prepared a draft table summarizing NOx emission control requirements and permitted emission levels for simple-cycle power plant gas turbines. This table, which includes information regarding limits for VOC, CO, PM_{10}, SO_2 and ammonia, shows that most of the recently permitted simple-cycle gas turbine projects in California have been required to meet VOC BACT limits of 2 ppmvd @ 15% O_2 on a 1- or a 3-hour average basis. The most recent of these BACT determinations was made by the SJVUAPCD for the Modesto Irrigation District Ripon project, which also consists of GE LM6000 Sprint gas turbines equipped with water injection and SCR for NOx control. For this project, which has been approved by the District and is expected to be licensed by the CEC before the end of 2003, VOC BACT was determined to be 2 ppmvd @ 15% O_2 on a 3-hour average basis.

The SCAQMD database included a December 2001 determination for the Wildflower Energy Indigo power plant that BACT for VOC for a simple-cycle LM5000 Sprint gas turbine was 2 ppm on a 1-hour average basis.

Federal NSPS

The NSPS applicable to new natural gas-fired combustion gas turbines are found in Title 40 CFR Part 60 Subpart GG. This NSPS does not specify an emission limit for VOC.

District Prohibitory Rules

Published prohibitory rules from the BAAQMD, SMAQMD, SDCAPCD, SJVUAPCD, and SCAQMD were reviewed to identify the VOC standards that govern existing natural gas-fired simple cycle combustion gas turbines. None of the prohibitory rules for combustion gas turbines, discussed previously in Section IV.A.3, specify an emission limit for VOC. Generic prohibitory rules (i.e., not device specific) from each of these districts were also reviewed; none contain an emission limit for VOC.

Conclusions

BACT must be at least as stringent as the most stringent BACT determination, federal NSPS, or district prohibitory rule. Based upon the results of this analysis, the BAAQMD BACT determination for natural gas-fired simple cycle combustion gas turbines, obtained from CARB's Guidance for Power Plant Siting and Best Available Control Technology, reflects the most stringent VOC emission limit. The BAAQMD established VOC emission limits of 2 ppmv @ 15% O_2 for natural gas-fired simple cycle combustion gas turbines. Therefore, BACT for VOC emissions from natural gas-fired simple cycle combustion gas turbines is 2 ppmv @ 15% O_2.

Particulate Matter Less Than 10 Microns in Diameter (PM_{10})

The BACT analysis performed for PM_{10} includes the following:

- Review of published BACT guidelines for comparable natural gas-fired simple cycle combustion turbines;
- Review of recent BACT decisions for natural gas-fired simple-cycle gas turbines;
- Review of federal NSPS for small natural gas-fired simple cycle combustion gas turbines; and
- Review of published prohibitory rules for comparable natural gas-fired simple cycle combustion gas turbines.

Published BACT Guidelines

Published BACT determinations from the following agencies were reviewed to identify any previously established BACT guidelines:

- ARB;
- BAAQMD;
- SJVUAPCD; and
- SCAQMD.

The ARB BACT Clearinghouse, as well as the BAAQMD and SJVUAPCD BACT guidelines, identify the use of natural gas as the primary fuel as "achieved in practice" for the control of PM_{10} for small simple cycle combustion gas turbines.

The ARB's BACT guidance document for electric generating units rated at less than 50 MW[26] indicates that BACT for the control of PM emissions from stationary gas turbines rated at less than 50 MW used in electrical generation is an emission limit corresponding to natural gas with fuel sulfur content of no more than 1 grain/100 standard cubic foot.

The SCAQMD database contained BACT determinations for the Los Angeles Department of Power and Water plant in Sun Valley, CA, and the Indigo Energy Facility in North Palm Springs, CA. The SCAQMD concluded that an exhaust PM_{10} concentration of 0.01 gr/dscf (equivalent to 11 lb/hr) constituted BACT.

Recent BACT Decisions

The ARB staff has prepared a draft table summarizing NOx emission control requirements and permitted emission levels for simple-cycle power plant gas turbines. This table, which includes information regarding limits for VOC, CO, PM_{10}, SO_2 and ammonia, shows that most of the recently-permitted simple-cycle gas turbine projects in California have been required to meet PM_{10} limits of 3.0 lb/hr.

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[26] Ibid, Table I-1.

Federal NSPS

Title 40 CFR Part 60 Subpart GG contains the applicable NSPS for combustion gas turbines. Section III.H previously identified the requirements of Subpart GG applicable to the proposed combustion gas turbine; Subpart GG does not regulate PM_{10} emissions.

District Prohibitory Rules

Published prohibitory rules from the District, SCAQMD, SJVUAPCD, SMAQMD, and SDCAPCD were reviewed to identify the PM_{10} standards that govern existing small natural gas-fired combustion gas turbines:

- BAAQMD adopted Rule 9-9 (Nitrogen Oxides from Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 9-9 does not regulate PM_{10} emissions.
- BAAQMD Regulation 6 (Particulate Matter and Visible Emissions) specifies a PM emission limit of 0.15 gr/dscf for sources of PM emissions.
- The SMAQMD adopted Rule 413 (Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 413 does not regulate PM_{10} emissions.
- SMAQMD Rule 404 (Particulate Matter) specifies a PM emission limit of 0.1 gr/dscf for sources of PM emissions.
- SMAQMD Rule 406 (Specific Contaminants) specifies a PM emission limit of 0.1 gr/dscf @ 12% CO_2 for combustion sources.
- The SDCAPCD adopted Rule 69.3.1 (Stationary Gas Turbine Engines – Best Available Retrofit Control Technology) to limit NOx emissions from these devices. Rule 69.3.1 does not regulate PM_{10} emissions.
- SDCAPCD Rule 52 (Particulate Matter) specifies a PM_{10} emission limit of 0.1 gr/dscf for sources of PM emissions.
- SDCAPCD Rule 53 (Specific Air Contaminants) specifies a PM emission limit of 0.1 gr/dscf @ 12% CO_2 for combustion sources.
- The SJVUAPCD adopted Rule 4703 (Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 4703 does not regulate PM_{10} emissions.
- SJVUAPCD Rule 4201 (Particulate Matter - Concentration) specifies a PM emission limit of 0.1 gr/dscf for sources of PM emissions.
- SJVUAPCD Rule 4301 (Fuel Burning Equipment) specifies a PM emission limit of 0.1 gr/dscf @ 12% CO_2 for combustion sources.
- The SCAQMD adopted Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines) to limit NOx emissions from these devices. Rule 1134 does not regulate PM_{10} emissions.
- SCAQMD Rule 404 (Particulate Matter - Concentration) specifies a PM emission limit of 0.0437 gr/dscf for sources of PM emissions.

- SCAQMD Rule 409 (Combustion Contaminants) specifies a PM emission limit of 0.1 gr/dscf @ 12% CO_2 for combustion sources.

Conclusions

BACT must be at least as stringent as the most stringent BACT determination, federal NSPS, or district prohibitory rule. Based upon the results of this analysis, the BAAQMD BACT guideline reflects the most stringent PM_{10} emission limit. The District established a requirement for the use of natural gas as the primary fuel to control PM_{10} emissions from combustion gas turbines. Therefore, the use of natural gas as the primary fuel source constitutes BACT for PM_{10} emissions from small simple cycle combustion gas turbines. Through the use of natural gas, the turbines are expected to be able to meet the proposed emission limit of 3.0 lb/hr per turbine.

Sulfur Oxides

The BACT analysis performed for SOx included the following:

- Review of published BACT guidelines for small natural gas-fired simple cycle combustion turbines;
- Review of recent BACT decisions for natural gas-fired simple-cycle gas turbines;
- Review of federal NSPS for small natural gas-fired simple cycle combustion gas turbines; and
- Review of published prohibitory rules for small natural gas-fired simple cycle combustion gas turbines.

Published BACT Guidelines

Published BACT determinations from the following agencies were reviewed to identify any previously established BACT guidelines:

- ARB;
- BAAQMD;
- SJVUAPCD; and
- SCAQMD.

The CARB BACT Clearinghouse, as well as the BAAQMD and SJVUAPCD BACT guidelines, identify the use of PUC-quality natural gas or natural gas with a limit on the sulfur content (i.e., 1 grain/100 scf) as the primary fuel as "achieved in practice" for the control of SOx for small simple cycle combustion gas turbines. The two most recent BACT determinations in the SCAQMD did not indicate BACT for SOx.

Recent BACT Decisions

The ARB staff has prepared a draft table of NOx emission controls required for simple-cycle power plant gas turbines. This table, which includes information regarding limits for VOC, CO, PM_{10}, SO_2 and ammonia) showed that most of the recently permitted simple-cycle gas turbine projects in California have been required to meet hourly SO_2 limits that correspond to fuel sulfur content limits of between 0.33 and 1.0 gr/100 scf.

Federal NSPS

Title 40 CFR Part 60 Subpart GG contains the applicable NSPS for combustion gas turbines. Section III.B previously identified the requirements of Subpart GG applicable to the proposed combustion gas turbine. A combustion gas turbine is subject to a SO_2 emission limit of 0.015% by volume (150 ppmv) @ 15% O_2. The NSPS also limits the sulfur content of fuel to 0.8% by weight.

District Prohibitory Rules

Published prohibitory rules from the BAAQMD, SJVUAPCD, and SCAQMD were reviewed to identify the SO_2 standards that govern existing gas turbines.

- BAAQMD Rule 9-9 (Nitrogen Oxides from Stationary Gas Turbines) is the BAAQMD's only prohibitory rule that specifically addresses gas turbines but does not limit SO_2 emissions. The BAAQMD adopted Rule 9-1 (Sulfur Dioxide) to limit SO_2 emissions from all sources. Rule 9-1 prohibits SO_2 emissions in excess of 300 ppm. No other BAAQMD Rule or Regulation contains a relevant prohibitory rule regulating either the sulfur content in the fuel or the emission of SO_2 from gas turbines.

- SJVUAPCD Rule 4703 (Stationary Gas Turbines) is the SJVUAPCD's only prohibitory rule that specifically addresses gas turbines but does not limit SO_2 emissions. The SJVUAPCD adopted Rule 4301 (Fuel Burning Equipment) to limit SO_2 emissions from these devices. Rule 4301 specifies a SO_2 emission limit of 200 pounds per hour. The SJVUAPCD also adopted Rule 4801 (Sulfur Compounds) to limit emissions of sulfur compounds. Rule 4801 specifies a SO_2 emission limit of 0.2%, or 2,000 ppm.

- SCAQMD Rule 1134 (Emissions of Oxides of Nitrogen from Stationary Gas Turbines) is the SCAQMD's only prohibitory rule that specifically addresses gas turbines but does not limit SO_2 emissions. The SCAQMD adopted Rule 431.1 (Sulfur Content of Gaseous Fuels) to reduce SOx emissions from the burning of gaseous fuels in stationary equipment. Rule 431.1 specifies a sulfur limit of 16 grains/100 scf (as H_2S) in natural gas sold within the SCAQMD. The SCAQMD also adopted Rule 407 (Liquid and Gaseous Air Contaminants) to limit SO_2 emissions from all sources. Rule 407 specifies an emission limit of 2,000 ppm for sulfur compounds (calculated as SO_2).

Conclusions

BACT must be at least as stringent as the most stringent BACT determination, federal NSPS, or district prohibitory rule. Based upon the results of this analysis, the CARB database and BAAQMD and SJVUAPCD BACT guidelines reflect the most stringent SOx emission limit. These sources established a requirement for the use of natural gas as the primary fuel to control SOx emissions from combustion gas turbines. Therefore, the use of natural gas as the primary fuel source constitutes BACT for SOx emissions from small simple cycle combustion gas turbines.

Summary

The criteria that constitute BACT for the proposed natural gas-fired simple cycle combustion gas turbine are summarized in Table 8.1E-4 and compared against the design criteria for the proposed combustion gas turbine.

Table 8.1E-4
Summary of Emission Limits and BACT Requirements

Pollutant	BACT	Proposed Control Level
NOx	Emission Limit = 2.5 ppmv @ 15% O_2	Design Exhaust Concentration = 2.5 ppmv @ 15% O_2
CO	Emission Limit = 4 ppmv @ 15% O_2	Design Exhaust Concentration = 4 ppmv @ 15% O_2
VOC	Emission Limit = 2 ppmv @ 15% O_2	Design Exhaust Concentration = 2 ppmv @ 15% O_2
SOx	Natural gas fuel	Natural gas fuel
PM_{10}	Natural gas fuel	Natural gas fuel

Figure 8.1E-1

SCR Cost-Effectiveness Calculation

1999 SCR Cost Comparison

			5 MW Class	25 MW Class	50 MW Class	150 MW Class	
Turbine Model			Solar Centaur 50	GE LM2500	GE LM6000	GE Frame 7FA	
Turbine Output			4.2 MW	23 MW	47.5 MW	161 MW	
Direct Capital Costs (DC)		Source					
Purchased Equip. Cost (PE)		MHIA					
Basic Equipment (A)		MHIA	$ 240,000	$ 660,000	$ 733,782	$ 210,000	
Ammonia injection skid and storage	0.00 x A	MHIA	included	included	included	included	
Instrumentation	0.00 x A	OAQPS	included	included	included	included	
Taxes and freight	0.08 A x B	OAQPS	$ 19,015	$ 52,746	$ 58,703	$ 169,530	
PE Total			$ 256,704	$ 712,066	$ 792,484	$ 2,288,649	
Direct Installation Costs (DI)							
Foundation & supports	0.08 x PE	OAQPS	$ 20,536	$ 56,965	$ 63,399	$ 183,092	
Handling and erection	0.14 x PE	OAQPS	$ 35,939	$ 99,689	$ 110,948	$ 320,411	
Electrical	0.04 x PE	OAQPS	$ 10,268	$ 28,483	$ 31,699	$ 91,546	
Piping	0.02 x PE	OAQPS	$ 5,134	$ 14,241	$ 15,850	$ 45,773	
Insulation	0.01 x PE	OAQPS	$ 2,567	$ 7,121	$ 7,925	$ 22,886	
Painting	0.01 x PE	OAQPS	$ 2,567	$ 7,121	$ 7,925	$ 22,886	
DI Total			$ 77,011	$ 213,620	$ 237,745	$ 686,595	
DC Total			$ 333,715	$ 925,686	$ 1,030,229	$ 2,975,244	
Indirect Costs (IC)							
Engineering:			$ 25,670	$ 71,207	$ 79,248	$ 100,000	
Construction and field expenses			$ 12,835	$ 35,603	$ 39,624	$ 114,432	
Contrctor fees			$ 25,670	$ 71,207	$ 79,248	$ 228,865	
Start-up			$ 5,134	$ 14,241	$ 15,850	$ 45,773	
Performance testing			$ 2,567	$ 7,121	$ 7,925	$ 22,886	
Contingencies			$ 7,701	$ 21,362	$ 23,775	$ 68,659	
IC Total			$ 79,578	$ 220,740	$ 245,670	$ 580,616	
Total Capital Investment (TCI = DC + IC)			$ 413,293	$ 1,146,426	$ 1,275,899	$ 3,555,860	
Direct Annual Costs (DAC)							
Operating Costs (O)	24 hrs/day, 7 days/wk, 50 wks/yr						
Operator	0.5 hrs/shift $25/hr	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125	
Supervisor	15% of Operator	OAQPS	$ 1,969	$ 1,969	$ 1,969	$ 1,969	
Maintenance Costs (M)							
Labor	0.5 hrs/shift $25/hr	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125	
Material	100% of labor cost	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125	
Utility Costs							
Perf Loss	0.50%						
Electricity cost	0.06 ($/kwh) performance penalt	variable	$ 10,584	$ 57,960	$ 119,700	$ 405,720	
Catalyst replacement			$ 10,352	$ 56,690	$ 117,077	$ 396,833	
Catalyst disposal			$ 388	$ 2,126	$ 4,391	$ 14,881	
Ammonia	$360/ton * tons NOx*17/46		$ 3,510	$ 14,820	$ 9,965	$ 108,257	
NH3 injection skid			$ 5,040	$ 7,560	$ 11,228	$ 77,589	
Total DAC			$ 71,218	$ 180,500	$ 303,705	$ 1,044,624	
Indirect Annual Costs (IAC)							
Overhead	60% of O&M		$ 24,806	$ 24,806	$ 24,806	$ 24,806	
Administrative	0.02 x TCI		$ 8,266	$ 22,929	$ 25,518	$ 71,117	
Insurance	0.01 x TCI		$ 4,133	$ 11,464	$ 12,759	$ 35,559	
Property tax	0.01 x TCI		$ 4,133	$ 11,464	$ 12,759	$ 35,559	
Capital recovery	10% interest rate, 15 yr period 0.13 x TCI		$ 53,037	$ 147,119	$ 163,734	$ 456,316	
Total IAC			$ 94,375	$ 217,782	$ 239,576	$ 623,357	
Total Annual Cost (DAC + IAC)			$ 165,593	$ 398,282	$ 543,281	$ 1,667,981	
NOx Emission Rate (tons/yr) at 25 ppm					88.2		
NOx Removed (TPY) at 2.5 ppm	90% removal efficiency				74.9		
Cost Effectiveness ($/ton)					7,253.41		
Electricity Cost Impact (c/kwh)					0.381		
Increased natural gas use					20,033	135,800	MCF
	1017 Btu/scf				20,373	138,109	MMBtu

Figure 8.1E-2

SCONOX Cost Effectiveness Calculation

1999 SCONOx Cost Comparison

			5 MW Class	25 MW Class	50 MW Class	150 MW Class
Turbine			Solar Centaur			GE Frame
Model			50	GE LM2500	GE LM6000	7FA
Turbine Output			4.2 MW	23 MW	47.5 MW	161 MW
Direct Capital Costs (DC)		Source				
Purchased Equip. Cost (PE)		Goalline				
Basic Equipment (A)		Goalline	$ 620,000	$ 1,960,000	$ 2,759,107	$ 7,700,000
Ammonia injection skid and storage	0.00 x A	Goalline	included	included	included	included
Instrumentation	0.00 x A	OAQPS	included	included	included	included
Taxes and freight	0.08 A x B	OAQPS	$ 49,760	$ 157,105	$ 220,729	$ 612,238
PE Total			$ 671,760	$ 2,120,916	$ 2,979,836	$ 8,265,208
Direct Installation Costs (DI)						
Foundation & supports	0.08 x PE	OAQPS	$ 53,741	$ 169,673	$ 238,387	$ 661,217
Handling and erection	0.14 x PE	OAQPS	$ 94,046	$ 296,928	$ 417,177	$ 1,157,129
Electrical	0.04 x PE	OAQPS	$ 26,870	$ 84,837	$ 119,193	$ 330,608
Piping	0.02 x PE	OAQPS	$ 13,435	$ 42,418	$ 59,597	$ 165,304
Insulation	0.01 x PE	OAQPS	$ 6,718	$ 21,209	$ 29,798	$ 82,652
Painting	0.01 x PE	OAQPS	$ 6,718	$ 21,209	$ 29,798	$ 82,652
DI Total			$ 201,528	$ 636,275	$ 893,951	$ 2,479,562
DC Total			$ 873,288	$ 2,757,191	$ 3,873,786	$ 10,744,770
Indirect Costs (IC)						
Engineering:			$ 67,176	$ 212,092	$ 297,984	$ 826,521
Construction and field expenses			$ 33,588	$ 106,046	$ 148,992	$ 413,260
Contrctor fees			$ 67,176	$ 212,092	$ 297,984	$ 826,521
Start-up			$ 13,435	$ 42,418	$ 59,597	$ 165,304
Performance testing			$ 6,718	$ 21,209	$ 29,798	$ 82,652
Contingencies			$ 20,153	$ 63,627	$ 89,395	$ 247,956
IC Total			$ 208,246	$ 657,484	$ 923,749	$ 2,562,214
Total Capital Investment (TCI = DC + IC)			$ 1,081,534	$ 3,414,675	$ 4,797,535	$ 13,306,985
Direct Annual Costs (DAC)						
Operating Costs (O)	24 hrs/day, 7 days/wk, 50 wks/yr					
Operator	0.5 hrs/shift $25/hr	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125
Supervisor	15% of Operator	OAQPS	$ 1,969	$ 1,969	$ 1,969	$ 1,969
Maintenance Costs (M)						
Labor	0.5 hrs/shift $25/hr	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125
Material	100% of labor cost	OAQPS	$ 13,125	$ 13,125	$ 13,125	$ 13,125
Utility Costs						
Perf Loss	0.50%					
Electricity cost	0.06 ($/kwh) performance penalt	variable	$ 10,584	$ 57,960	$ 119,700	$ 428,400
Catalyst replacement	(note 2)		$ 25,880	$ 106,295	$ 219,522	$ 785,655
Catalyst disposal	precious metal recovery: 1/3 replacement cost		$ (8,618)	$ (35,396)	$ (73,174)	$ (261,623)
H2 carrier steam	(note 3)		$ 19,686	$ 107,806	$ 222,643	$ 796,824
H2 reforming	(note 4)		$ 1,916	$ 10,495	$ 21,674	$ 77,589
H2 skid demand	(note 5) (0.6 kW/MW capacity)		$ 1,270	$ 6,955	$ 14,364	$ 51,408
Total DAC			$ 92,062	$ 295,459	$ 566,073	$ 1,919,597
Indirect Annual Costs (IAC)						
Overhead	60% of O&M		$ 24,806	$ 24,806	$ 24,806	$ 24,806
Administrative	0.02 x TCI		$ 21,631	$ 68,293	$ 95,951	$ 266,140
Insurance	0.01 x TCI		$ 10,815	$ 34,147	$ 47,975	$ 133,070
Property tax	0.01 x TCI		$ 10,815	$ 34,147	$ 47,975	$ 133,070
Capital recovery	10% interest rate, 15 yr period 0.13 x TCI		$ 138,791	$ 438,198	$ 615,658	$ 1,707,659
Total IAC			$ 206,859	$ 599,592	$ 832,366	$ 2,264,744
Total Annual Cost (DAC + IAC)			$ 298,920	$ 895,050	$ 1,398,439	$ 4,184,341

NOx Emission Rate (tons/yr) at 25 ppm		88.2		
NOx Removed (TPY) at 2.5 ppm	90% removal efficiency	74.9		
Cost Effectiveness ($/ton)		18,670.74		
Electricity Cost Impact (c/kwh)		0.981		
Increased natural gas use		35,994	244,000	MCF
	1017 Btu/scf	36,606	248,148	MMBtu

Note 2: 300 kcfh/MW; s.v.=20 kcfh/ft^3; $1,500/$ft^3$ catalyst; 7 yr. life
Note 3: Scaled from GE LM2500 data in SYCOM report table
Note 4: Scaled from GE LM2500 data in SYCOM report table
Note 5: Interpolated for LM6000 from data for LM2500 and Frame 7FA in SYCOM report table

APPENDIX 8.1F

Cumulative Impacts Analysis for the SFERP Facility

APPENDIX 8.1F

CUMULATIVE IMPACTS ANALYSIS FOR THE SFERP FACILITY

8.1F OVERVIEW OF THE ANALYSIS

Cumulative air quality impacts from the SFERP and other reasonably foreseeable projects are both regional and localized in nature. Regional air quality impacts are possible for pollutants such as ozone, which is formed through a photochemical process that can take hours to occur. Carbon monoxide, NOx and SOx impacts are generally localized in the area in which they are emitted. PM_{10} can create a local air quality problem in the vicinity of its emission source, but can also be a regional issue when it is formed in the atmosphere from POC, SOx and NOx.

This cumulative impacts analysis considers the potential for both regional and localized impacts due to emissions from proposed operation of SFERP. Regional impacts were evaluated by comparing maximum daily and annual emissions from SFERP with emissions of ozone and PM_{10} precursors in both San Francisco County and the entire BAAQMD. Localized impacts were evaluated by looking at other local sources of pollutants that are not included in the background air quality data to determine whether these sources in combination with SFERP would be expected to cause significant cumulative air quality impacts.

The modeling shows that the SFERP is not expected to contribute significantly to cumulative localized NO_2 or PM_{10} ambient impacts. Nonetheless, there will be impacts from the SFERP in both Potrero and Bayview/Hunters Point. To address these concerns, the City is developing, with community input, a PM_{10} community benefit package. The City will target the mitigations to the areas affected by the impacts from the project.

8.1F-1 Regional Impacts

Regional impacts are evaluated by assessing SFERP's contribution to regional emissions. Although the relative importance of POC and NOx emissions in ozone formation differs from region to region and from day to day, state law requires reductions in emissions of both precursors to reduce both Bay Area and downwind air basin ozone levels. The change in the sum of emissions of these pollutants, equally weighted, provides a rough estimate of the impact of SFERP on regional ozone levels. Similarly, a comparison of the emissions of PM_{10} precursor emissions from SFERP with regional PM_{10} precursor emissions provides an estimate of the impact of SFERP on regional PM_{10} levels.

Under BAAQMD regulations, SFERP will be required to provide offsets for increases in NOx emissions from the project at a 1.15 to 1 ratio. SFERP will also provide additional NOx ERCs to mitigate total NOx and POC emissions from the project at a 1.0 to 1 ratio. Therefore, emissions of ozone precursors from the project will be fully mitigated. While SFERP is developing a mitigation program to address potential PM_{10} impacts from the project, the benefits of this mitigation program have not been considered in this cumulative impact analysis. Regulatory offset requirements are calculated based on tons per year of emissions from the project. The inventories are expressed in tons per day of emissions; comparisons are shown on both a daily and annual basis.

The following tables summarize these comparisons; detailed calculations are shown in the attached tables. SFERP emissions are compared with regional emissions in 2005, as the project is expected to begin operation in the second quarter of 2007. San Francisco County and BAAQMD emissions projections for 2005 were taken from the Air Resources Board's web-based emission inventory projection software, available at www.arb.ca.gov/app/emsinv/emssumcat.php.

These comparisons show that even when mitigation is not accounted for, SFERP emissions will have an extremely small impact on regional ozone and PM_{10} formation. When mitigation is taken into account, regional cumulative impacts will be almost negligible. An additional, unquantified benefit of the project will be the displacement of generation from older, less efficient and higher emitting generating facilities in San Francisco. The emissions comparison below does not account for the longer-term reductions expected from future retrofits and/or shutdowns of units at the Potrero and Hunters Point power plants. Potential future reductions under various scenarios are shown in the tables that are included in the attachment to this appendix.

Table 8.1F-1
Comparison of SFERP Emissions to Regional Precursor Emissions in 2005: Daily Basis

	San Francisco County		BAAQMD
Ozone Precursors – Daily Basis			
Total Ozone Precursors, tons/day	99.2		939.0
Total SFERP Ozone Precursor Emissions, tons/day		0.42	
SFERP Ozone Precursor Emissions as Percent of Regional Total	0.42%		0.04%
SFERP Offsets, average tons/day		0.13	
SFERP Ozone Precursor Emissions after offsets, tons/day[1]		0.29	
SFERP Ozone Precursor Emissions as Percent of Regional Total, after offsets	0.29%		0.03%
PM_{10} Precursors – Daily Basis			
Total PM_{10} Precursors, tons/day	118.8		1218.0
Total SFERP PM_{10} Precursors, tons/day		0.55	
SFERP PM_{10} Precursors as Percent of Regional Total	0.46%		0.04%
SFERP Offsets, average tons/day		0.13	
SFERP PM_{10} Precursors after offsets, tons/day	0.35%		0.03%

8.1F-2 Localized Impacts

The AFC presented the results of several dispersion modeling analyses to allow evaluation of the localized impacts of emissions from SFERP. The results are summarized in Table 8.1F-3 below (from Table 8.1-28 of the AFC).

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[1] The 0.29 tons per day difference between SFERP ozone precursor emissions and the offsets to be obtained for the SFERP reflects the difference between the **maximum** possible daily emissions from the SFERP, assuming that all three units are operating, and the **average** daily emissions represented by the offsets. As show in table 8.1F-2, on an annual basis, the SFERP will obtain offsets for **all** its ozone precursor emissions at a 1.0 to 1 ratio.

Table 8.1F-2
Comparison of SFERP Emissions to Regional Precursor Emissions in 2005: Annual Basis*

	San Francisco County		BAAQMD
Ozone Precursors – Annual Basis			
Total Ozone Precursors, tons/year	36,208		342,735
Total SFERP Ozone Precursor Emissions, tons/year		47.5	
SFERP Ozone Precursor Emissions as Percent of Regional Total	0.13%		0.01%
SFERP Offsets, tons/year		47.5	
SFERP Ozone Precursor Emissions after offsets, tons/year		0	
PM_{10} Precursors – Annual Basis			
Total PM_{10} Precursors, tons/year	43,362		444,570
Total SFERP PM_{10} Precursor Emissions, tons/year		68.4	
SFERP PM_{10} Precursor Emissions as Percent of Regional Total	0.16%		0.02%
SFERP Offsets, tons/year		47.5	
SFERP PM_{10} Precursor Emissions after offsets, tons/year	0.05%		<0.01%

Note: * County and BAAQMD emissions calculated as 365 times daily emissions.

Table 8.1F-3
Maximum Modeled Project Impacts and PSD Significance Thresholds

Pollutant	Averaging Prd	Max Facility Impact, ug/m^3	PSD Significance Threshold, ug/m^3
NOx	1-hour	8.3	19[a]
	annual	0.1	1.0
SO_2	3-hour	1.0	25
	24-hour	0.1	5
	annual	0.006	1.0
CO	1-hour	27.8	2000
	8-hour	6.3	500
PM_{10}[b]	24-hour	1.2	5
	annual	0.2	1.0

Notes:
a. BAAQMD significance threshold only.
b. Includes cooling tower.

As shown in the table, SFERP impacts are well below the significance thresholds. As project impacts are not significant as that term is defined in federal air quality modeling guidelines, no significant cumulative impacts are expected to occur. At present, there are no PSD significance thresholds for $PM_{2.5}$.

The only pollutants for which SFERP could be considered to have the potential for significant impacts are NOx and PM_{10}, because the BAAQMD is currently classified as a nonattainment area with respect to state air quality standards for both ozone (for which NOx is a precursor) and PM_{10}, and for the new national 8-hour ozone standard.[2]

To evaluate potential cumulative impacts of SFERP in combination with other projects in the area, we requested from the BAAQMD staff information regarding projects in San Francisco County for which permits to construct have been issued but had not yet begun operation. The list provided by the District staff included 25 facilities. As discussed in the cumulative impacts protocol, projects for which the emissions changes are smaller than 5 tons per year are assumed to be *de minimis* and are not included in the dispersion modeling analysis. Therefore only three projects, with permitted NOx emissions increases of 16.2, 18.9 and 7.1 tons per year, respectively, are included in the cumulative impacts analysis. However, two additional operating facilities, PG&E Hunters Point and Mirant Potrero power plants, were also considered in the dispersion modeling analysis to assess potential localized cumulative air quality impacts for NO_2 and PM_{10}.

Three different modeling analyses were performed to evaluate various future Hunters Point and Potrero operating scenarios. Maximum future emissions from SFERP and the three new facilities were modeled for each scenario. As Hunters Point and Potrero historical emissions are reflected in ambient background concentrations, future operating scenarios evaluate differences in NOx and PM_{10} emissions at the power plants relative to historical levels.

- Maximum future emissions: Future generation at Hunters Point and Potrero would be increased to the maximum levels allowed under existing permits and equipment ratings. Future NOx emissions from Hunters Point Unit 4 and Potrero Unit 3 would be controlled to comply with BAAQMD regulatory requirements, so NOx emissions from these units are modeled as reductions. The difference between average historical and maximum future NOx and PM_{10} emissions from Hunters Point Units 1 and 4 and Potrero Units 3, 4, 5 and 6 are modeled as increases.
- Hunters Point and Potrero operating at historic levels: Future generation at Hunters Point and Potrero would remain at historical levels; however, future NOx emissions from Hunters Point Unit 4 and Potrero Unit 3 would be lower to comply with BAAQMD regulatory requirements. The difference between average historical and projected future NOx emissions from the boilers are treated as reductions. There is no change in PM_{10} emissions.
- Potrero and Hunters Point shut down: Average historical NOx and PM_{10} emissions from all units are modeled as reductions.

Under any reasonably foreseeable scenario, Hunters Point will be shut down. The City does not expect that the Hunters Point power plant will continue to operate beyond 2007. In addition, as described in section 3, Purpose and Need, and section 4, Environmental Justice, the SFERP, in combination with certain additional projects, will provide for the termination of the RMR Agreement for units at the Potrero power plant. The removal of the RMR Agreement from units at the Potrero Power Plant would eliminate an important source of revenue to Mirant from continued operation of the units and would allow the owner, Mirant Potrero LLC, to shut down the units.

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[2] The Bay Area is designated as an attainment area for the national 1-hour average ozone standard and the national PM_{10} air quality standards. The District is unclassified for the national $PM_{2.5}$ air quality standards.

All three future scenarios assume that Potrero Unit 7 will not be built. The Applicant does not believe it is reasonably foreseeable that Potrero Unit 7 will be constructed and operated for the following reasons:

1. The proponent of Potrero Unit 7, Mirant, is in bankruptcy proceedings and the Potrero Unit 7 licensing proceeding has been suspended since November 13, 2003; and
2. It is formal City policy to oppose the construction of Potrero Unit 7.

Accordingly, the City considers the construction of Potrero Unit 7 to be highly unlikely.

The results of the cumulative impact modeling analysis are summarized in the tables below. These results show that the maximum modeled NO_2 and PM_{10} impacts of SFERP are much smaller than the maximum modeled impacts of the other cumulative impact sources. These other sources, which are assumed to be backup Diesel engine generators, are expected to have very high but very localized one-hour and annual average NO_2 impacts. Because their impacts are localized, they do not overlap with impacts from SFERP, Potrero or Hunters Point. Modeled impacts from SFERP and the three other cumulative impact sources are shown in Figures 8.1F-1 through 8.1F-4. The available models do not correctly calculate the negative emission changes (reductions). The presence of the negative emission rates in each case prevents us from including the Potrero and Hunters Point units in the isopleths, although the results for these units are presented in the tables.

The overall reductions from the shutdown of the existing power plants are much larger than the maximum increases in modeled ambient concentrations from the new project. Nonetheless, the modeled impacts in particular locations do not directly overlap and thus do not fully cancel one another out. Because of the relative locations of the Potrero power plant and the SFERP, the Potrero modeled impacts partially overlap with the SFERP modeled impacts. However, the Hunters Point power plant is far enough away that its modeled impacts do not coincide with the maximum impact from the SFERP. If generation at Potrero power plant remains at historical levels, the modeling shows that once the power plant boiler is retrofitted to meet the limitations of the District power plant NOx rule the reductions in maximum modeled NO_2 impacts from this unit will offset some of the localized modeled NO_2 increases from the proposed project. If generation at Potrero is increased to the maximum levels allowable under existing permits, the modeling shows that there will be localized increases in NO_2 and PM_{10} concentrations due to the increased operation. If the existing power plants are shut down, the modeling shows that localized reductions in ambient NO_2 and PM_{10} impacts would directly offset some of the localized impacts of the SFERP.

In summary, the modeling shows that the SFERP is not expected to contribute significantly to cumulative localized NO_2 or PM_{10} ambient impacts. Nonetheless, there will be PM_{10} impacts from the SFERP in both Potrero and Bayview/Hunters Point. To address these concerns, the City is developing, with community input, a PM_{10} mitigation/community benefits package. The City will target the mitigation to the areas affected by the impacts from the project.

Table 8.1F-4

Cumulative Air Quality Impacts: Scenario A (Potrero and Hunters Point at Historical Generating Levels with Required NOx Retrofits)

Pollutant/ Avg. Prd.	Maximum Modeled Concentration, ug/m^3 At Location of SFERP Max Impact				Maximum Modeled Concentration, ug/m^3 At Location of Maximum Combined Impact				Current Background[c]	Total Cumulative Impact, All Sources, ug/m^3
	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total		
NOx: 1-hr avg	8.3	0	-[illegible].1	[illegible].2	0	172	0	172	141	313
NOx: annual avg[e]	0.1	0.1	-0.4	-0.2	0.02	11.4	-0.1	11.3	36	47
PM_{10}: 24-hr avg	1.2	0.01	0	1.2	0	8.7	0	8.7	74	82.7
PM_{10}: annual avg	0.2	0.01	0	0.2	0.02	0.6	0	0.6	26.3	26.9

Notes:

a. SF Self Storage, SF Wave Exchange and UCSF.

b. Potrero and Hunters Point future emissions based on historical generating levels; compliance with future regulations.

c. Maximum monitored ambient concentrations at Arkansas Street, 2001-2003.

d. 1-hr avg NOx ozone-limited using concurrent ozone data for hour of maximum modeled impact.

e. Annual average NOx ozone-limited using ARM and national default factor of 0.75.

Table 8.1F-5

Cumulative Air Quality Impacts: Scenario B (Potrero and Hunters Point Maximum Future Emissions)

Pollutant/ Avg. Prd.	Maximum Modeled Concentration, ug/m³ At Location of SFERP Max Impact				Maximum Modeled Concentration, ug/m³ At Location of Maximum Combined Impact				Current Background[c]	Total Cumulative Impact, All Sources, ug/m³
	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total		
NOx: 1-hr avg	8.3	0	34.4	42.7	0	172	0	172	141	313
NOx: annual avg[e]	0.1	0.1	0.3	0.5	0.02	11.4	0.1	11.5	36	48
PM_{10}: 24-hr avg	1.2	0.01	1.2	2.4	0	8.4	0	8.7	74	82.7
PM_{10}: annual avg	0.2	0.01	0.2	0.4	0.02	0.5	0.03	0.7	26.3	27.0

Notes:

a. SF Self Storage, SF Wave Exchange and UCSF.

b. Potrero and Hunters Point future emissions based on maximum allowable generating levels; compliance with future regulations.

c. Maximum monitored ambient concentrations at Arkansas Street, 2001-2003.

d. 1-hr avg NOx ozone-limited using concurrent ozone data for hour of maximum modeled impact.

e. Annual average NOx ozone-limited using ARM and national default factor of 0.75.

Table 8.1F-6

Cumulative Air Quality Impacts: Scenario C (Potrero and Hunters Point Shut Down)

Pollutant/ Avg. Prd.	Maximum Modeled Concentration, ug/m^3 At Location of SFERP Max Impact				Maximum Modeled Concentration, ug/m^3 At Location of Maximum Combined Impact				Current Background[c]	Total Cumulative Impact, All Sources, ug/m^3
	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total	SFERP	Other Cumulative Sources[a]	POT/HP[b]	Total		
NOx: 1-hr avg	8.3	0	-1.7	6.6	0	172	0	172	141	313
NOx: annual avg[e]	0.1	0.1	-0.9	-0.7	0.02	11.4	-0.2	11.2	36	47
PM_{10}: 24-hr avg	1.2	0.01	-0.9	0.3	0	8.7	0	8.7	74	82.7
PM_{10}: annual avg	0.2	0.01	-0.15	0.05	0.02	0.6	-0.02	0.6	26.3	26.9

Notes:

a. SF Self Storage, SF Wave Exchange and UCSF.

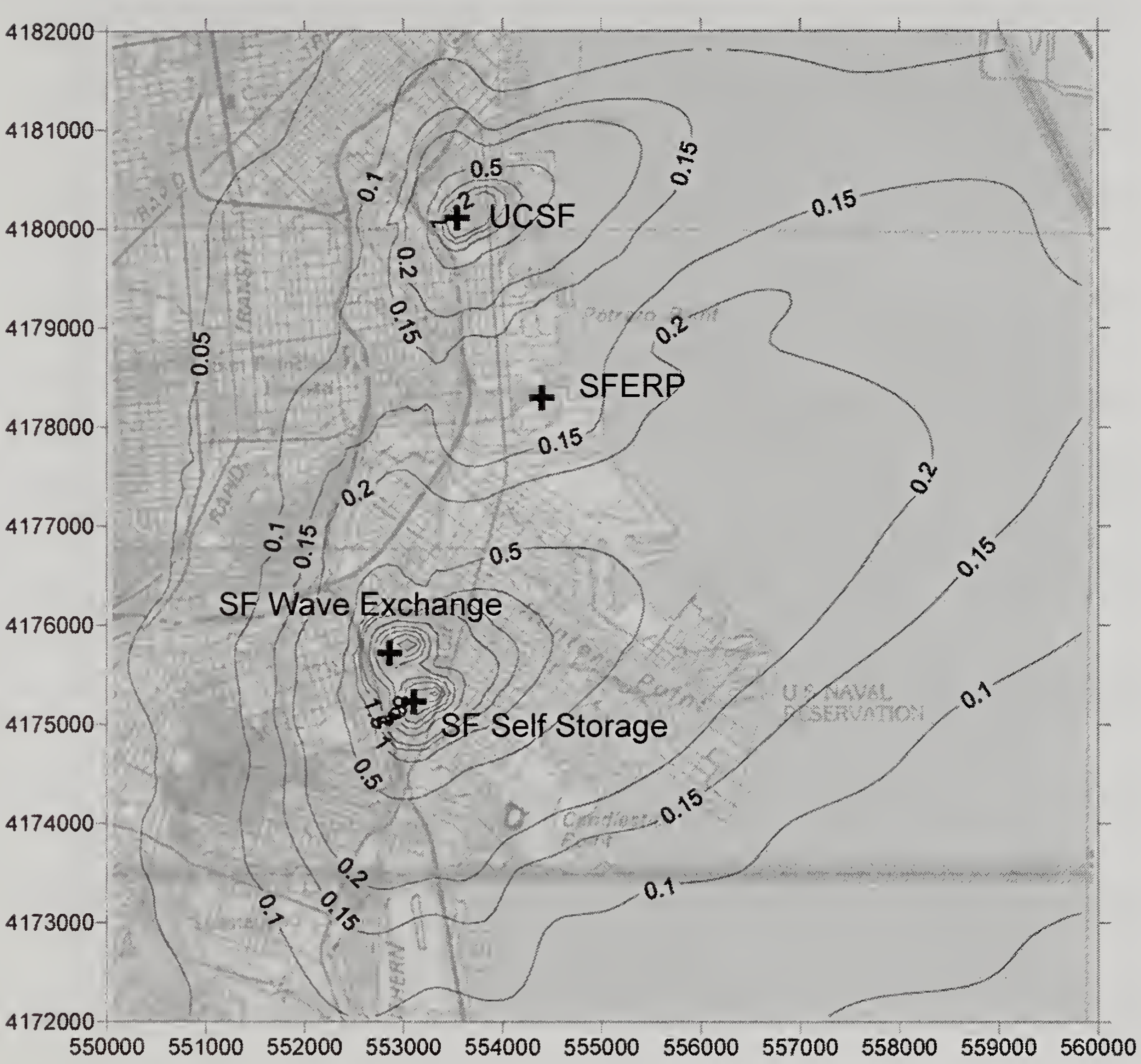
b. Potrero and Hunters Point shut down.

c. Maximum monitored ambient concentrations at Arkansas Street, 2001-2003.

d. 1-hr avg NOx ozone-limited using concurrent ozone data for hour of maximum modeled impact.

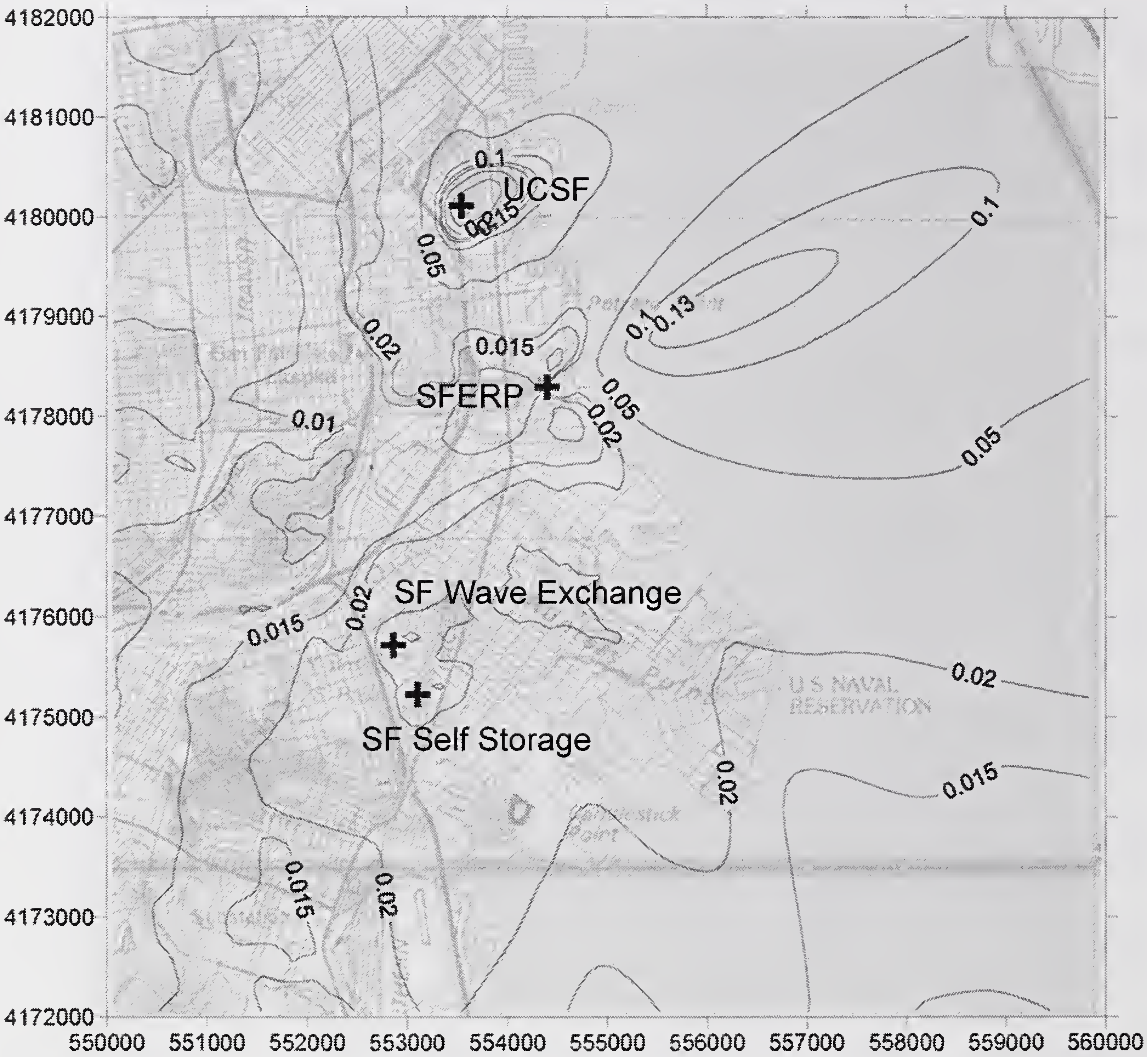
e. Annual average NOx ozone-limited using ARM and national default factor of 0.75.

Figure F-1
San Francisco Electric Reliability Project
Cumulative Impacts for Annual Average NO_2 (μg/m^3)
(Modeled concentrations shown are not ozone limited)



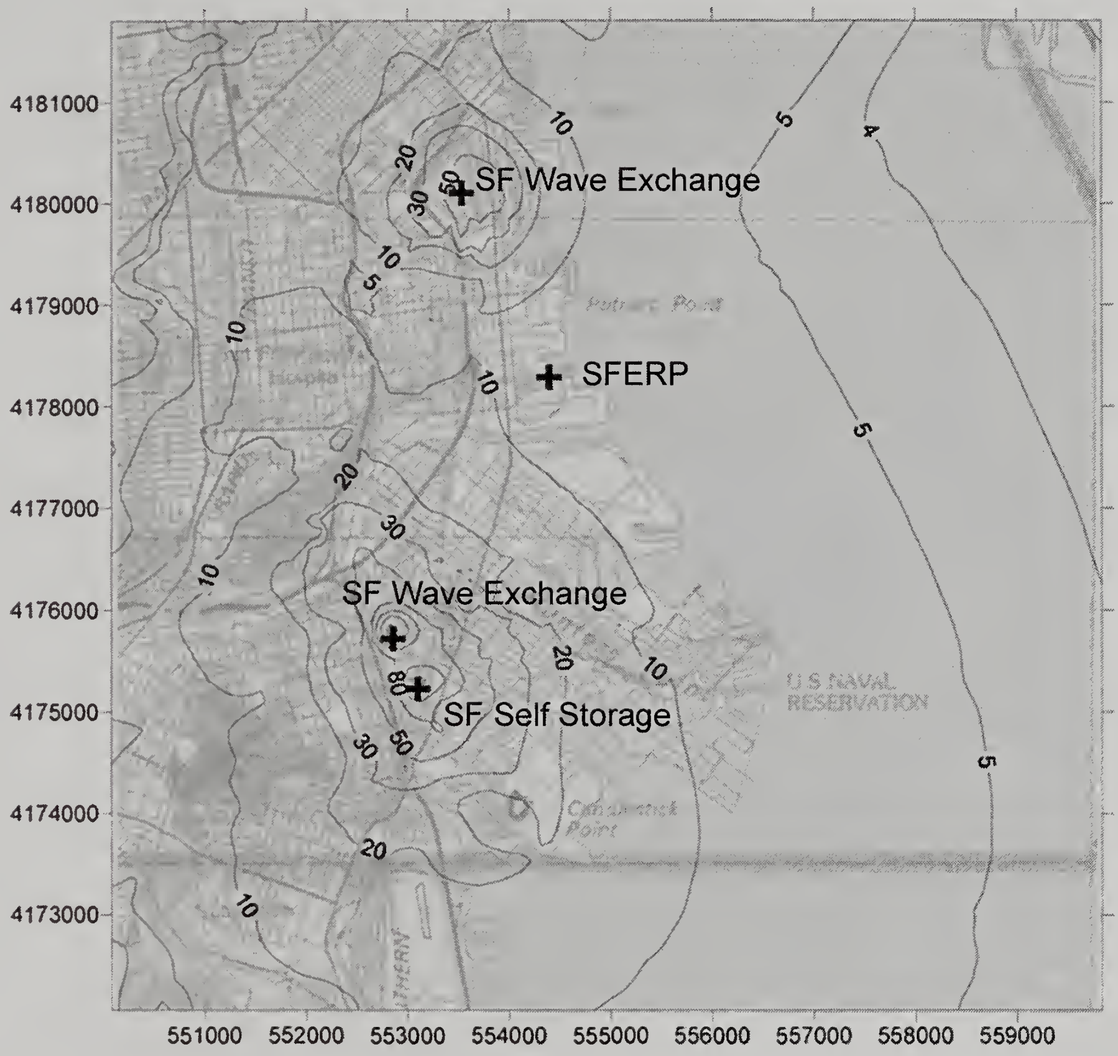
This figure shows the highest modeled annual average NO_2 impact from new sources in the project area that are not already in operation and therefore are not included in monitored background concentrations. The + symbols indicate the location of each modeled source.

Figure F-2
San Francisco Electric Reliability Project
Cumulative Impacts for Annual Average PM_{10} ($\mu g/m^3$)



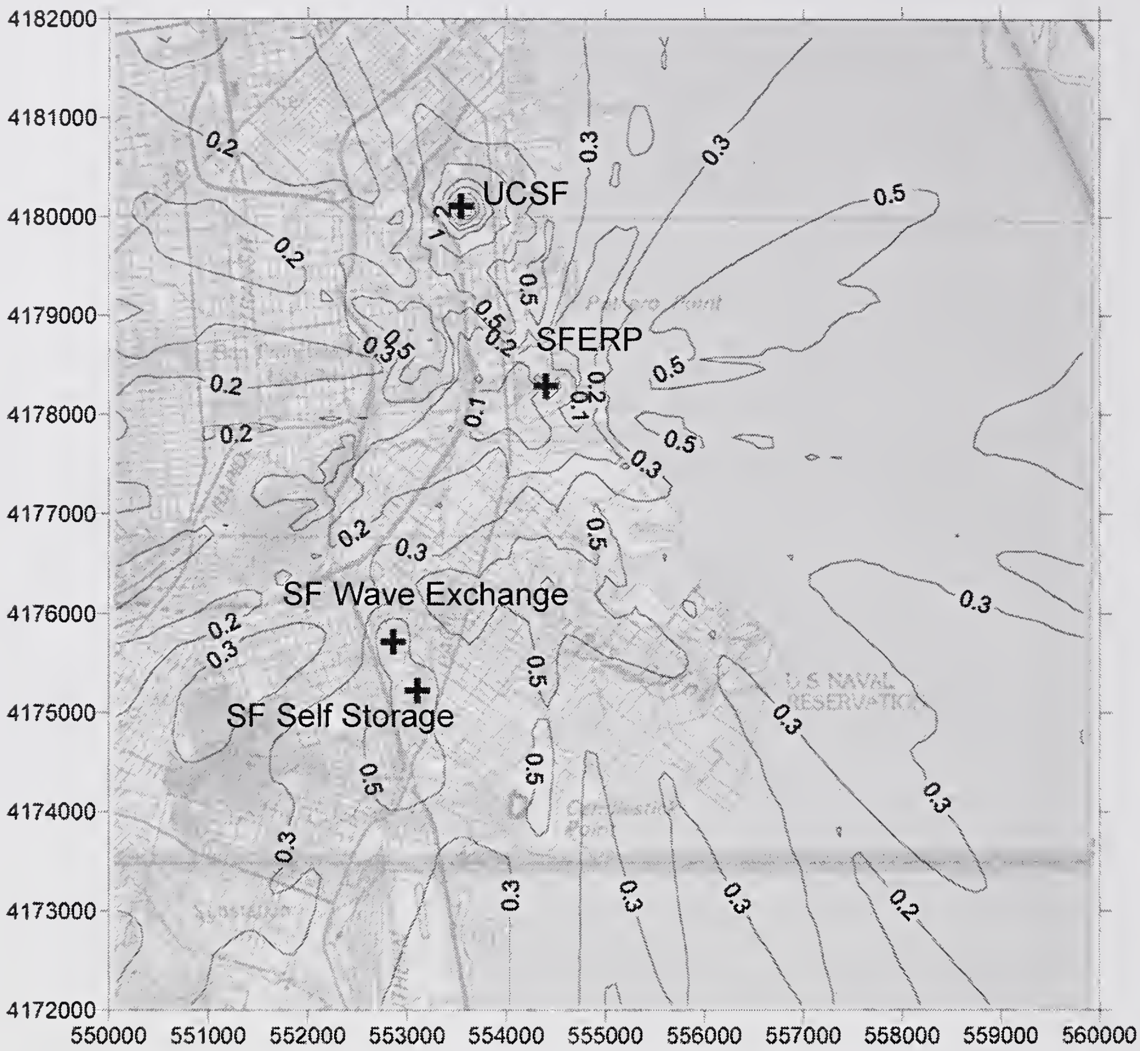
This figure shows the highest modeled annual average PM_{10} impact from new sources in the project area that are not already in operation and therefore are not included in monitored background concentrations. The + symbols indicate the location of each modeled source.

Figure F-3
San Francisco Electric Reliability Project
Cumulative Impacts for One-Hour Average NO_2 (μg/m³)



This figure shows the highest modeled one-hour average NO_2 impact from new sources in the project area that are not already in operation and therefore are not included in monitored background concentrations. The + symbols indicate the location of each modeled source.

Figure F-4
San Francisco Electric Reliability Project
Cumulative Impacts for 24-Hour Average PM_{10} ($\mu g/m^3$)



This figure shows the highest modeled 24-hour average PM_{10} impact from new sources in the project area that are not already in operation and therefore are not included in monitored background concentrations. The + symbols indicate the location of each modeled source.

Potrero Power Plant: Rated Capacities and Historical Operations

							Fuel Use			
							2001	2002	2003	3-Year Avg
Unit ID	Source ID	Type	Rated Capacity, MW	Rated Heat Input, MMBtu/hr	Operating Limits?	NOx Em Limits	MMBtu	MMBtu	MMBtu	MMBtu
3	1	steam boiler	206	2150	no	0.018 lbs/Mmbtu (1)	10,683,200	5,927,227	8,590,000	8,400,142
4A	10	peaking turbine	26	406	877 hrs/yr	65 ppm	97,860	66,640	125,580	96,693
4B	11	peaking turbine	26	406	877 hrs/yr	65 ppm	302,820	68,880	125,860	165,853
5A	12	peaking turbine	26	406	877 hrs/yr	65 ppm	324,100	67,900	80,220	157,407
5B	13	peaking turbine	26	406	877 hrs/yr	65 ppm	347,760	66,640	76,720	163,707
6A	14	peaking turbine	26	406	877 hrs/yr	65 ppm	358,120	55,300	70,840	161,420
6B	15	peaking turbine	26	406	877 hrs/yr	65 ppm	336,560	57,400	70,560	154,840
Total			362				12,450,420	6,309,987	9,139,780	9,300,062

Note: (1) NOx emission limit effective 1/1/06.

Potrero Power Plant

	NOx Emissions				SOx Emissions				CO Emissions			
	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg
Unit ID	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
3	368.5	366.3	199.3	311.4	3.2	3.2	2.5	3.0	209.9	208.6	167.8	195.4
4A	18.2	5.6	16.3	13.4	8.0	2.5	3.2	4.5	3.0	0.9	5.1	3.0
4B	16.9	17.4	16.3	16.9	7.4	7.6	3.2	6.1	2.8	2.9	5.1	3.6
5A	37.3	47.1	10.4	31.6	6.5	8.2	2.0	5.5	2.5	3.1	3.2	2.9
5B	42.6	50.6	9.9	34.4	7.4	8.8	1.9	6.0	2.8	3.4	3.1	3.1
6A	36.2	41.8	9.2	29.1	7.8	9.0	1.8	6.2	3.0	3.4	2.9	3.1
6B	35.3	39.3	9.1	27.9	7.6	8.5	1.8	5.9	2.9	3.2	2.8	3.0
Total	554.9	568.1	270.6	464.5	47.8	47.7	16.4	37.3	227.0	225.6	190.0	214.2

Potrero Power Plant

	POC Emissions				PM10 Emissions			
	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg
Unit ID	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
3	9.2	9.1	7.0	8.4	15.9	15.8	12.7	14.8
4A	0.7	0.2	0.3	0.4	5.9	1.8	0.8	2.8
4B	0.7	0.7	0.3	0.6	5.5	5.6	0.8	4.0
5A	0.6	0.8	0.2	0.5	4.8	6.0	0.5	3.8
5B	0.7	0.8	0.2	0.6	5.4	6.5	0.5	4.1
6A	0.7	0.9	0.2	0.6	5.8	6.6	0.4	4.3
6B	0.7	0.8	0.2	0.6	5.6	6.2	0.4	4.1
Total	13.4	13.3	8.2	11.7	48.8	48.6	16.1	37.8

Potrero Power Plant: Max Future Emissions

Unit	Fuel Use, MMBtu/yr (1)	Emission Factor, lb/MMBtu (2)					Proj Future Emissions, tpy		3-yr Avg Emissions, tpy		Max Increment, tpy		Future NOx, tpy	Increment from Baseline, tpy
		NOx	SO2	CO	VOC	PM10	NOx	PM10	NOx	PM10	NOx	PM10	NOx	NOx
3	18,834,000	0.018				0.004	169.51	33.13	311.35	14.78	-141.85	18.35	83.70	-227.65
4A	356,062	0.276				0.059	49.19	10.42	13.36	2.83	35.83	7.59		
4B	356,062	0.203				0.048	36.23	8.49	16.88	3.95	19.35	4.53		
5A	356,062	0.401				0.048	71.47	8.50	31.60	3.76	39.88	4.74		
5B	356,062	0.420				0.050	74.76	8.97	34.37	4.12	40.39	4.85		
6A	356,062	0.360				0.053	64.13	9.45	29.07	4.28	35.06	5.16		
6B	356,062	0.361				0.053	64.20	9.43	27.92	4.10	36.28	5.33		
Total							529.48	88.39						

Notes:

(1) Based on max. permitted operation (8760 hrs/yr for boiler, 877 hrs/yr per turbine)

(2) Future NOx emissions calculated from 3-yr average fuel use rate and 2005 emission limit of 0.018 lb/MMBtu

Hunters Point Power Plant: Rated Capacities and Historical Operations

							Fuel Use			
							2001	2002	2003	3-Year Avg
Unit ID	Source ID	Type	Rated Capacity, MW	Rated Heat Input, MMBtu/hr	Operating Limits?	NOx Em Limits	MMBtu	MMBtu	MMBtu	MMBtu
1	1	peaking turbine	26	356	877 hrs/yr	65 ppm	227,780	37,268	33,572	99,540
1	2	peaking turbine	26	356	877 hrs/yr	65 ppm	227,780	37,268	33,572	99,540
2	3	steam boiler	--	--	shut down	--	0	0	0	0
2	4	steam boiler	--	--	shut down	--	0	0	0	0
3	5	steam boiler	--	--	shut down	--	0	0	0	0
3	6	steam boiler	--	--	shut down	--	0	0	0	0
4	7	steam boiler	163	1720	no	0.018 lb/MMBtu (1)	4,486,825	5,319,800	3,150,000	4,318,875
Total			215				4,942,385	5,394,336	3,217,144	4,517,955

Note: (1) NOx emission limit effective 1/1/05.

Hunters Point PowerPlant

	NOx Emissions					SOx Emissions				CO Emissions			
	2000	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg
Unit ID	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
1	5.9	33.9	32.0	4.7	23.5	27.6	26.0	0.4	18.0	2.3	2.2	0.3	1.6
1	5.9	33.9	32.0	4.7	23.5	27.6	26.0	0.4	18.0	2.3	2.2	0.3	1.6
2	90.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	63.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	108.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	100.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	197.6	167.4	153.8	107.9	143.0	1.4	1.3	0.9	1.2	95.3	87.6	61.4	81.5
Total	572.3	235.3	217.8	117.3	190.1	56.6	53.2	1.7	37.2	100.0	92.0	62.1	84.7

Hunters Point Power Plant

	POC Emissions				PM10 emissions			
	2001	2002	2003	3-Year Avg	2001	2002	2003	3-Year Avg
Unit ID	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
1	0.6	0.5	0.1	0.4	4.5	4.2	0.6	3.1
1	0.6	0.5	0.1	0.4	4.5	4.2	0.6	3.1
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.2	3.8	2.7	3.6	7.2	6.6	4.7	6.2
Total	5.3	4.9	2.8	4.4	16.2	15.1	5.9	12.4

Hunters Point Power Plant: Max Future Emissions

Unit	Fuel Use, MMBtu/yr (1)	Emission Factor, lb/MMBtu (2)					Max Future Em. Tpy		3-yr Average Emissions, tpy		Max. Increment, tpy		Future NOx, tpy	Reduction, tpy
		NOx	SO2	CO	VOC	PM10	NOx	PM10	NOx	PM10	NOx	PM10	NOx	NOx
1	312,212	0.473	0.361	0.033	0.008	0.063	73.84	9.77	23.5	3.11	50.30	6.65		
2	312,212	0.473	0.361	0.033	0.008	0.063	73.84	9.77	23.54	3.11	50.30	6.65		
4	15,067,200	0.018	0.001	0.038	0.002	0.003	135.60	21.50	143.04	6.16	-7.43	15.34	38.87	-104.17
Total							283.29	41.04						

Notes:
(1) Fuel use for peaker turbines based on 877 hrs/yr of peaking generation; fuel use for boiler based on average use during 2000-2002.
(2) Unit 4 NOx emission factors from permit limits. All others from calculated from BAAQMD emission inventory reports

APPENDIX 8.2C

Nitrogen Deposition Impact Analysis on San Bruno Mountain

APPENDIX 8.2C

Nitrogen Deposition Impact Analysis on San Bruno Mountain

8.2C.1 Calculation of Nitrogen Deposition Baseline

8.2C.1.1 General Methodology

The general methodology used in estimating the nitrogen deposition baseline is that relied upon by Dr. Stuart Weiss (1999). This method starts with deposition measurements reported by Blanchard, et al. (1996), and makes adjustments for location and surface composition. In this analysis, we make further adjustments to reflect reductions in ambient pollutant concentrations over the 10- to 15-year period since the data collection effort reflected in Blanchard's work.

The starting values for deposition are taken from Table 12 of Blanchard's report, and represent long-term average deposition rates, on a quarterly basis, for various species in Fremont, California. (Deposition data from Fremont, California, were used in this analysis because Fremont has the nearest available dry deposition monitoring station to the project site. Fremont and San Francisco are located in the same air basin [meaning the two locations share common air quality characteristics] and Fremont data were determined to be the most representative data available. Other monitoring sites are located in the Sacramento and San Joaquin valleys and southern California, farther from the project site and outside of the air basin.) These values are adjusted from their ionic bases to a nitrogen basis, and then are further adjusted for surface composition; location change; and recent pollution reduction efforts. Each of these adjustments is further discussed below.

8.2C.1.2 Surface Composition

Weiss notes that deposition rates vary as a function of surface composition. The data collected by Blanchard at Fremont represented an "urban mix" of surfaces, while the San Bruno Mountain is principally green grasslands during the fall and winter months. To address this type of difference, Weiss applied correction factors, obtained from Blanchard, to reflect different deposition rates during fall and winter months. Weiss provided similar correction factors for use in the analysis that was prepared in 2000 for grassland areas in the San Jose area. These same correction factors were applied, on a species-specific basis, to the first and fourth calendar quarter deposition rates, for this analysis.

8.2C.1.3 Location Differences

Weiss further adjusted the deposition rates measured in Fremont to reflect differing levels of ozone and nitrogen dioxide in the San Jose area. In particular, a factor of 1.3 was applied to deposition of NO_2 and NO_3 to reflect higher concentrations of nitrogen dioxide in San Jose as compared with Fremont. Similarly, a factor of 1.2 was applied to nitric acid (HNO_3) deposition to reflect higher concentrations of ozone in San Martin (south of San Jose) as compared with Fremont. For the current analysis, we looked at ozone and nitrogen dioxide data from Fremont and San Francisco. The data used to develop the correction factors are shown in Table 8.2C-1 (all tables appear at the end of this appendix). The revised analysis resulted in factors of 1.018 for nitrogen dioxide and 0.623 for ozone (reflecting lower concentrations of ozone in San Francisco than in Fremont).

8.2C.1.4 Recent Emission Reductions

To further refine the estimate, an additional correction factor was added that reflected the air quality improvements that have been observed in the Bay Area over the last 10 years. The original deposition measurements covered the period between 1988 and 1993 at Fremont. For that period of time, the California Air Resources Board (CARB) reported three relevant statistics for ozone (top four 8-hour average ozone levels; annual average ozone level; and annual average of daily maximum ozone level), and one relevant statistic for nitrogen dioxide (annual average). Each of these values is shown in Table 8.2C-1 for each year between 1988 and 1993, along with the average for the 6-year period.

For the most recent 3 years for which data are available (2002-2004), the only relevant ozone statistic available is the top four 8-hour average ozone levels. Consequently, we used the average of the top four 8-hour average ozone levels as a measure of the relative change in ozone concentrations between the two time periods (1988-93 vs. 2002-04). This metric is a good indicator of the relative severity of the ozone season and, by using multi-year averages, is a good indicator of the change in emissions loading in the region independent of year-to-year fluctuations in ambient concentrations due to meteorology.

Using this metric, it was concluded that ozone levels in 2002-04 range from 3 percent higher to 12 percent lower than the levels observed in 1988-93 when the deposition data were collected. Similarly, looking at the change in annual average NO_2 concentrations, it was concluded that levels of this pollutant have been reduced 27 percent since the earlier period. Consequently, a final adjustment factor of 0.955 for ozone and 0.73 for nitrogen dioxide was applied. Consistent with Weiss' methodology, the ozone adjustment was applied to HNO_3, and the NO_2 adjustment was applied to NO_2 and NO_3.

In conclusion, the current best estimate of nitrogen deposition in the vicinity of San Bruno Mountain is 6.17 kilograms/hectare/year (kg/ha/year). This estimate is probably conservatively high, based on Weiss's statement that "[p]eninsula sites have lower deposition, 4-6 kg/ha/year" (Weiss, 1999). The results of our analysis, including all adjustment factors, are presented in Table 8.2C-2.

8.2C.2 Nitrogen Deposition Modeling Methodology

8.2C.2.1 Overview of Modeling Procedure

The SFERP modeling analysis used the Industrial Source Complex Short Term, Version 3 (ISCST3) model, to evaluate the project's air quality impacts. ISCST3 is a steady-state, mass-conserving, nonreactive (i.e., no chemistry) Gaussian plume dispersion model.

All three turbines were modeled. These are the only sources at the site with emissions of nitrogen-containing compounds. The calculation of nitrogen emissions for use in this modeling analysis are shown in Table 8.2C-3.

To produce conservative results (overestimates), conservative assumptions regarding the complex chemistry that occurs to produce nitrogen from NO_x and ammonia were used. These assumptions lead to an exceedingly conservative estimation of nitrogen deposition, because areas with the highest nitrogen emissions do not necessarily experience the greatest deposition effects, which usually occur far from the original nitrogen source. In addition, since mass is conserved in the model, all downwind calculations of nitrogen deposition, regardless of distance and formation rates, are overestimated by the model.

The ISCST3 model calculates atmospheric deposition of nitrogen by calculating the wet and dry fluxes of total nitrogen. This deposition is accomplished by using a resistance model for the dry deposition part, and by assigning scavenging coefficients for the wet removal process from rainout. As discussed below, depositional parameters are input into the model to calculate the deposition of nitrogen.

8.2C.2.2 Chemical Transformation of NO_x Emissions

The oxidation of nitrogen oxides is a complicated process that can include a large variety of nitrogen compound, such as nitrogen dioxide (NO_2), nitric acid (HNO_3) and organic nitrates (RNO_3) such as peroxyacetylnitrate (PAN). Atmospheric chemical reactions that occur in sunlight result in the formation of ozone and other compounds. Depending on atmospheric conditions, these reactions can start to occur within several hundred meters of the original NO_x source, or after the pollutants have been carried tens of kilometers downwind. Ultimately, some nitrogen oxides are converted to nitric acid vapor or particulate nitrates. Precipitation is one mechanism that removes these pollutants from the air. Forms of atmospherically-derived nitrogen are removed from the atmosphere both by wet deposition (rain) and dry deposition (direct uptake by vegetation and surfaces).

Ammonia (NH_3) and ammonium (NH_4) are other forms in which nitrogen occurs. Ammonia is a gas that becomes ammonium when dissolved in water, or when present in soils or airborne particles. Unlike NO_x, which forms during combustion, soil microorganisms naturally form ammonia and ammonium compounds from nitrogen and hydrogen.

In urban atmospheres, the oxidation rate of NO_x to HNO_3 is estimated to be approximately 17 percent per hour, with a range of 10 to 30 percent per hour (CARB, 1986). Aerosol nitrates (NO_3) are present, mainly in the form of ammonium nitrate (NH_4NO_3). Nitrate and ammonium are the predominant forms by which plants absorb nitrogen. In California, ammonium nitrate is the predominant airborne nitrate-bearing particle in the atmosphere (CARB, 1986). The SFERP analysis used the CARB estimate of 17 percent immediate conversion of NO_x to HNO_3.

8.2C.2.3 Nitrogen Deposition Mechanisms

The ISCST3 wet and dry deposition modeling for gaseous pollutants is based on the algorithm contained in the CALPUFF dispersion model (USEPA, 1995), which Moore, et al., reviewed and evaluated (1995). The deposition flux, F_d, is calculated as the product of the concentration, Π_d, and a deposition velocity, v_d, computed at a reference height z_d:

The dry deposition algorithm is based on an approach that expresses the deposition velocity as the inverse sum of total resistance. The resistance represents the opposition to transporting the pollutant through the atmosphere to the surface. ISCST3 incorporates several resistance models that include aerodynamic resistance, canopy resistance, cuticle resistance, deposition layer resistance, mesophyll resistance, and stomatal action.

With wet deposition, gaseous pollutants are scavenged by dissolution into cloud droplets and precipitation. A scavenging ratio approach was used to model the deposition of gases through wet removal. In this approach, the flux of material to the surface through wet deposition (Fw) is the product of a scavenging ratio times the concentration, integrated in the vertical direction.

8.2C.2.4 Model Inputs

To model gaseous deposition, the following inputs are required:

- The molecular diffusivity for the pollutant being modeled (cubic centimeters per second [cm2/s])
- The solubility enhancement factor (a*) for the pollutant
- The pollutant reactivity parameter
- The mesophyll resistance term (rm) for the pollutant (s/cm),
- The Henry's Law coefficient for the parameter

In addition to the above inputs, the dry and wet deposition algorithm also requires surface roughness length (cm), friction velocity (meters per second), Monin-Obukhov length (meters), leaf index ratio, precipitation type, and precipitation rate. Site-specific meteorology was used in this analysis and was based on the 1992 data set collected at the adjacent Potrero Power Plant. Hourly cloud cover, relative humidity and solar radiation data, which were required for the modeling analysis but were not available from the Potrero meteorological data set, were taken from San Francisco Airport (cloud cover and RH) and the nearest CIMIS station (solar radiation) in Fremont.

ISCST3 calculates depositional flux at user-specified locations, called receptors. Receptors were placed at 100-meter intervals throughout the park on along the park boundaries, producing more than 1100 locations where deposition was calculated in the model.

8.2C.2.5 Results of the Modeling Analysis

The impact over the critical area was determined using the average deposition rate over the area. Impacts were modeled over the entire area of San Bruno Mountain.

The average modeled nitrogen deposition from the project over the area is estimated to be 0.0059 kg/ha/year, or less than 0.1 percent of existing background levels. The total nitrogen deposition is the project impact of 0.0059 kg/ha/year plus the background of 6.17 kg/ha/year equaling a total impact of 6.175 kg/ha/year. This modeling analysis does not take into account the NO_x emission reduction credits being provided for the project, which will offset much of the nitrogen emissions increase from SFERP. The applicant will provide 47.5 tons per year of NO_x ERCs, which will result in a 14.5-ton-per-year reduction in nitrogen emissions. This represents 33 percent of the 44.4 tons per year of nitrogen from the new facility.

Modeling input and output files are being provided with the air quality modeling files on CD.

8.2C.3 Cumulative Impacts

Current nitrogen deposition background levels on San Bruno Mountain reflect the impacts of operation of the Hunters Point and Potrero power plants. Historical operation of those power plants provides a baseline for the assessment of potential future cumulative impacts.

Three potential future operating scenarios were evaluated. As discussed in Appendix 8.1F, the City considers it highly unlikely that the Hunters Point power plant will continue to operate beyond 2007. However, one of the future operating scenarios assumes continued operation of the Hunters Point power plant to conservatively overestimate future nitrogen deposition impacts.

In the first scenario, it was assumed that both Potrero and Hunters Point power plants would continue to operate at historical levels (that is, future annual heat input to each unit would be equal to the average annual heat input over the past three years), that the boilers at each plant would meet the 2006 NO_x regulatory limit of 0.018 pounds/Million British Thermal Units (lb/MMBtu) using selective catalytic reduction (SCR) systems with 10 ppm ammonia slip, and that no additional controls would be installed on the peaking turbines. In the second scenario, it was assumed that the Potrero power plant would continue to operate at historical levels, with Boiler 3 controlled using SCR to meet the District's regulatory NO_x limit (0.018 lb NO_x/MMBtu effective 1/1/06) with 10 ppm ammonia slip (corrected to 3 percent O_2), and that the Hunters Point power plant would be shut down. In the third scenario, it was assumed that both the Potrero and Hunters Point power plants would be shut down. All scenarios include the NO_x reductions from the offsets to be provided for SFERP.

Calculations for each scenario are shown in Table 8.2C-4. These calculations show that even with SFERP and continued operation of the Hunters Point and Potrero power plants with SCR control, there will be a net reduction of over 52 tons per year of nitrogen emissions in southeast San Francisco. Even with the addition of SFERP and the continued operation of the Potrero power plant, the shutdown of Hunters Point will result in a net reduction in nitrogen emissions of approximately 86 tons per year. If both the Potrero and Hunters Point power plants are shut down, the area will see a net reduction in nitrogen emissions of about 169 tons per year.

8.2C.4 References

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California Air Resources Board (CARB) (1986): Dry Deposition of Acidic Gases and Particles, February 1986.

Moore, G., P. Ryan, D. Schwede, and D. Strimaitis, 1995: Model performance evaluation of gaseous dry deposition algorithms. Paper 95-TA34.02, 88th Annual Meeting & Exhibition of the Air and Waste Management Association, San Antonio, Texas, June 18-23.
U.S. Environmental Protection Agency (1995): Interagency Workgroup on Air Quality Modeling (IWAQM): Assessment of Phase 1 Recommendations Regarding the Use of MESOPUFF II. EPA-454/R-95-006.

Weiss, S. 1999. "Cars, Cows and Checkerspot Butterflies Nitrogen Deposition and Management of Nutrient-Poor Grasslands for a Threatened Species." *Conservation Biology* 13: 1476-1486.

Table 8.2C-1
San Francisco Electric Reliability Project
Nitrogen Deposition Analysis - Related Air Quality Data

	Fremont - Chapel				San Francisco - Arkansas St				Ratio - San Francisco:Fremont			
Year	**Avg of Top 4 8-hr Avg O3 ppm**	**Ann Avg O3 ppm**	**Ann Avg Daily Max O3 ppm**	**Ann Avg NO2 ppm**	**Avg of Top 4 8-hr Avg O3 ppm**	**Ann Avg O3 ppm**	**Ann Avg Daily Max O3 ppm**	**Ann Avg NO2 ppm**	**Avg of Top 4 8-hr Avg O3 ppm**	**Ann Avg O3**	**Ann Avg Daily Max O3**	**Ann Avg NO2**
1988	0.086	0.019	0.043	0.026	0.060			0.026	0.692	0.000	0.000	1.000
1989	0.081	0.018	0.041	0.025	0.053			0.026	0.657	0.000	0.000	1.040
1990	0.073	0.017	0.039	0.023	0.050			0.021	0.682	0.000	0.000	0.913
1991	0.074	0.019	0.040	0.024	0.044			0.024	0.598	0.000	0.000	1.000
1992	0.074	0.017	0.039	0.021	0.047			0.022	0.639	0.000	0.000	1.048
1993	0.091	0.020	0.043	0.022	0.045			0.024	0.489	0.000	0.000	1.091
Average	0.080	0.018	0.041	0.024	0.050			0.024	0.623	0.000	0.000	1.014
2002	0.066			0.019	0.046			0.019				
2003	0.077			0.017	0.054			0.018				
2004	0.067			0.014	0.053			0.016				
Average	0.070			0.017	0.051			0.018	0.731			1.060
Change: 2002-2004 vs 1988-93	-12%			-29%	3%			-26%				

Table 8.2C-2
Nitrogen Deposition - Baseline Calculation
San Francisco Electric Reliability Project

	Gas-Phase Species			Particulate			
	HNO3	NO2	NH3	NO3	NH4	Total	
1st Calendar Quarter							
Fremont Data (88-94)	3.220	9.010	1.110	0.740	0.160	14.240	kg/ha-year (from Blanchard et al, Table 12)
Fremont Data (88-94)	0.716	2.742	0.914	0.167	0.124	4.663	kg/ha-year (as N)
Grassland Adjustment	1.058	1.805	3.189	2.364	3.187		ratio
Adjusted Fremont Data (88-94)	0.757	4.949	2.915	0.395	0.397	9.413	kg/ha-year (as N)
Fremont -> SFERP Adjustments							
for ozone	0.623						ratio
for NO2		1.014		1.014			ratio
Adjusted SFERP (88-94)	0.472	5.018	2.915	0.400	0.397	9.202	kg/ha-year (as N)
Current Year Adjustment (88-94 to 02-04)							
for ozone	0.955						ratio
for NO2		0.730		0.730			ratio
Adjusted SFERP Baseline (02-04)	0.450	3.663	2.915	0.292	0.397	7.718	kg/ha-year (as N)
2nd Calendar Quarter							
Fremont Data (88-94)	5.940	7.790	1.010	0.730	0.100	15.570	kg/ha-year (from Blanchard et al, Table 12)
Fremont Data (88-94)	1.320	2.371	0.832	0.165	0.078	4.765	kg/ha-year (as N)
Grassland Adjustment	1.000	1.000	1.000	1.000	1.000		ratio
Adjusted Fremont Data (88-94)	1.320	2.371	0.832	0.165	0.078	4.765	kg/ha-year (as N)
Fremont -> SFERP Adjustments							
for ozone	0.623						ratio
for NO2		0.730		0.730			ratio
Adjusted SFERP (88-94)	0.822	1.731	0.832	0.120	0.078	3.583	kg/ha-year (as N)
Current Year Adjustment (88-94 to 02-04)							
for ozone	0.955						ratio
for NO2		0.730		0.730			ratio
Adjusted SFERP Baseline (02-04)	0.785	1.263	0.832	0.088	0.078	3.046	kg/ha-year (as N)
3rd Calendar Quarter							
Fremont Data (88-94)	10.770	9.290	1.200	0.860	0.170	22.290	kg/ha-year (from Blanchard et al, Table 12)
Fremont Data (88-94)	2.393	2.827	0.988	0.194	0.132	6.535	kg/ha-year (as N)
Grassland Adjustment	1.000	1.000	1.000	1.000	1.000		ratio
Adjusted Fremont Data (88-94)	2.393	2.827	0.988	0.194	0.132	6.535	kg/ha-year (as N)
Fremont -> SFERP Adjustments							
for ozone	0.623						ratio
for NO2		1.014		1.014			ratio
Adjusted SFERP (88-94)	1.491	2.867	0.988	0.197	0.132	5.675	kg/ha-year (as N)
Current Year Adjustment (88-94 to 02-04)							
for ozone	0.955						ratio
for NO2		0.730		0.730			ratio
Adjusted SFERP Baseline (02-04)	1.424	2.093	0.988	0.144	0.132	4.781	kg/ha-year (as N)
4th Calendar Quarter							
Fremont Data (88-94)	2.820	11.600	1.110	1.350	0.230	17.110	kg/ha-year (from Blanchard et al, Table 12)
Fremont Data (88-94)	0.627	3.530	0.914	0.305	0.179	5.555	kg/ha-year (as N)
Grassland Adjustment	1.058	1.805	3.189	2.364	3.187		ratio
Adjusted Fremont Data (88-94)	0.663	6.371	2.915	0.721	0.570	11.240	kg/ha-year (as N)
Fremont -> SFERP Adjustments							
for ozone	0.623						ratio
for NO2		1.014		1.014			ratio
Adjusted SFERP (88-94)	0.413	6.460	2.915	0.731	0.570	11.090	kg/ha-year (as N)
Current Year Adjustment (88-94 to 02-04)							
for ozone	0.955						ratio
for NO2		0.730		0.730			ratio
Adjusted SFERP Baseline (02-04)	0.394	4.716	2.915	0.533	0.570	9.129	kg/ha-year (as N)
Annual Average							
Adjusted SFERP Baseline (02-04)						6.169	kg/ha-year (as N)

Table 8.2C-3
Nitrogen Deposition Emission Rates
San Francisco Electric Reliability Project

NOx emission rate = 13.27 tpy per turbine
N/NO2 molecular weight ratio (14/46) = 0.304347826
N emission rate from NO2 = 4.04 tpy per turbine
0.1162 g/s per turbine
N emission rate for modeling contribution from NO2= 0.0197 g/s per turbine

NH3 emission rate = 13.08 tpy per turbine
N/NH3 molecular weight ratio (14/17) = 0.823529412
N emission rate from NH3 = 10.77 tpy per turbine
N emission rate for modeling contribution from NH3= 0.3099 g/s per turbine

Emission rates based on annual average values
Use 17% conversion rate for N from NO2 only

Table 8.2C-4
San Francisco Electric Reliability Project
Nitrogen Emissions: Cumulative Impacts

Scenario 1: Continued Operation of Potrero and Hunters Point at Historical Levels with SCR on Boilers

	Emissions, tons per year				
Source	**NOx**	**N from NOx**	**NH3**	**N from NH3**	**Total N**
SFERP: Project Emissions	39.8	12.1	39.2	32.3	44.4
SFERP: NOx Offsets	-47.5	-14.5	--	--	-14.5
Hunters Point: Continued Historical Operation (1)	-104.2	-31.7	8.6	7.1	-24.6
Mirant Potrero: Continued Historical Operation (1)	-235.7	-71.7	16.8	13.8	-57.9
Total					-52.5

Scenario 2: Shutdown of Hunters Point, Continued Operation of Potrero at Historical Levels with SCR on Boiler 3

	Emissions, tons per year				
Source	**NOx**	**N from NOx**	**NH3**	**N from NH3**	**Total N**
SFERP: Project Emissions	39.8	12.1	39.2	32.3	44.4
SFERP: NOx Offsets	-47.5	-14.5	--	--	-14.5
Hunters Point: Plant Shutdown (2)	-190.1	-57.9	--	--	-57.9
Mirant Potrero: Continued Historical Operation (1)	-235.7	-71.7	16.8	13.8	-57.9
Total					-85.8

Scenario 3: Shutdown of Hunters Point and Potrero

	Emissions, tons per year				
Source	**NOx**	**N from NOx**	**NH3**	**N from NH3**	**Total N**
SFERP: Project Emissions	39.8	12.1	39.2	32.3	44.4
SFERP: NOx Offsets	-47.5	-14.5	--	--	-14.5
Hunters Point: Plant Shutdown (2)	-190.1	-57.9	--	--	-57.9
Mirant Potrero: Plant Shutdown (2)	-464.5	-141.4	--	--	-141.4
Total					-169.3

Notes:
1. Based on average emissions and fuel use during 2001-2003, with boilers controlled to 0.018 lb NOx/MMBtu using SCR with ammonia slip rate of 10 ppm @ 3% O2 and. no additional controls on peaking turbines.
2. Based on average emissions and fuel use during 2001-2003.

APPENDIX 8.3A

Resume of Douglas M. Davy, Ph.D.

Douglas M. Davy, Ph.D.
Consulting Archaeologist

SUMMARY OF EXPERIENCE

Twenty-two years of experience in cultural resources management, including prehistoric and historic archaeology, and historic buildings and structures, and Native American consultation. Eighteen years of experience as a manager of archaeological field projects in support of regulatory compliance programs for energy, transportation, mineral and water resources development, and hazardous materials management projects.

REPRESENTATIVE PROJECTS

Cultural Resources Testing and Evaluation for 30 sites in Management Region 5, Edwards Air Force Base, U.S. Army Corps of Engineers. Project Manager and co-Principal Investigator for archaeological testing and National Register of Historic Places evaluation of 30 prehistoric archaeological sites located in the Precision Impact Range Area at Edwards Air Force Base, western Mojave Desert, California. Prepared archaeological research design and work plan for test excavations and laboratory analysis and served as Project Director, coauthor, and general editor of final report. Project is part of a long-range sampling program for compliance with Section 106 of the National Historic Preservation Act.

Eastern Transportation Corridor; Transportation Corridor Agencies - Project Archaeologist/Principal Investigator for 24-mile-long multi-lane toll road in Orange County, California. Directed construction monitors, consulted with 5 Native American Tribes, prepared Archaeological Resources Management Plan, developed and managed test excavation and laboratory analysis program to determine National Register eligibility of 22 archaeological sites discovered during construction and authored survey and excavation reports. Directed data recovery excavations to mitigate impacts to prehistoric rockshelter site and three deeply buried, Early Holocene sites discovered during construction.

Vancouver to Sacramento Fiber Optic Conduit Installation Project, 360networks, Incorporated – Project Archaeologist/Principal Investigator for long-haul fiber optic conduit installation program between Vancouver, Washington, and Sacramento, California. Consulted with Federal agencies and Native American tribes, prepared Archaeological Resources Treatment Plans, agreement documents, and heritage resources inventory reports; directed archaeological field survey and test excavations; and managed team of 5 archaeologists and more than 20 Native Americans monitoring construction. Coordinated with Forest Service in emergency discovery situations.

Statewide Historic Buildings and Structures Inventory, DoD Installations, State of California; U.S. Army Corps of Engineers, Sacramento District. Project Manager for inventory and overview of buildings and structures surveys for 93 military bases in California. Prepared inventory and analysis of studies and coordinated with a team of Architectural Historians. Co-authored one of three report volumes. Project involved literature search and historic context development for California as a region and for the Cold War and Korean War periods. The resulting report serves as a guide for all future historic buildings and structures inventories in California. Project review committee included representatives of each of the four military service branches, State Historic Preservation Office, Advisory Council on Historic Preservation, and National Park Service. This project won the Governor's Historic Preservation Award for 2001.

Integrated Cultural Resources Management Plans, U.S. Army Corps of Engineers. Project Manager for preparation, under separate task orders, of Integrated Cultural Resources Management Plans for four military installations: Sierra Army Depot, northern California; Deseret Chemical Depot, Utah; Naval Weapons Station, Seal Beach, southern California; and Naval Weapons Station, Fallbrook Detachment. Each of the plans involved a review of inventoried archaeological sites and historic buildings and structures, an assessment of regulatory compliance plans and procedures for Section 106 of the National Historic Preservation Act and other regulations at each installation, and development of recommendations for continued regulatory compliance and future work.

Northend Landfill Capping and Shoreline Protection Project; Naval Ordnance Center Pacific Division, U.S. Navy Engineering Field Activity Northwest - Principal Investigator for landfill capping and shoreline protection project. Conducted test investigations to determine National Register eligibility of prehistoric shell midden site, consulted with 5 Native American tribes, prepared Archaeological Resources Treatment Plan for data recovery to mitigate adverse effects on a prehistoric archaeological site. Directed scientific data recovery excavation as a mitigation measure at buried site in tidal zone. Principal author of scientific data recovery report. Prepared Memorandum of Agreement between the Navy, State Historic Preservation Office, Native American Tribes, and Advisory Council on Historic Preservation.

Gilroy Energy Center, Calpine Corporation. - Project Archaeologist for California Energy Commission Application for Certification for merchant thermal power plant. Planned and conducted cultural resources inventories and prepared license application. Prepared Monitoring and Mitigation Plan and supervised construction monitoring. Conducted presence-absence testing program for buried archaeological deposits at site of zero liquid discharge system, planned and managed data recovery excavations for protohistoric site encountered during construction of the natural gas pipeline.

Devil's Nose/Cross County Water-Power Project FERC License Application; Amador County Water Resources Agency – Principal Investigator for cultural resources field inventory, National Register evaluation, and Native American consultation, for a 121-MW water supply reservoir and hydroelectric project involving a 1,000-acre reservoir in central California. Directed archaeological survey, recorded 52 archaeological sites and conducted field program to determine their eligibility for listing on the National Register of Historic Places. Coordinated cultural resources management activities with U.S. Forest Service, Office of Historic Preservation, Native American tribes, and other agencies.

Historic Properties Survey of Selected Areas at Fort Peck Lake; U.S. Army Corps of Engineers, Missouri River Division - Project Archaeologist/Principal Investigator for archaeological survey of 4,000 acres at Fort Peck Lake, eastern Montana as a technical study in support of the EIS for the Missouri River Master Water Control Manual. Recorded 49 archaeological sites and analyzed reservoir shoreline erosion effects on historic properties. Principal author of survey report for compliance with Section 106 of the National Historic Preservation Act in conjunction with the Missouri River Master Water Control Manual Environmental Impact Statement.

Kelso-Beaver Pipeline FERC License Application; Portland General Electric Company - Principal Investigator for FERC license application for a 17-mile-long natural gas pipeline in southwestern Washington and northwestern Oregon. Conducted a records search, literature search, and field surveys and consulted with four Native American groups and the State Historic Preservation Office for Section 106 National Historic Preservation Act compliance.

Sly Park Flashboards EA; El Dorado Irrigation District – Principal Investigator for National Register evaluations of two prehistoric sites located on the shorelines of a reservoir in east-central California for reservoir expansion project. Planned and directed archaeological excavations to evaluate the sites, and prepared site evaluation report. Consulted with the Bureau of Reclamation, State Historic Preservation Office, and Native American tribes.

Piñon Pine Power Project; Sierra Pacific Power Company - Principal Investigator for historic properties survey and site evaluation program for a coal gasification project in west-central Nevada. Conducted field survey to identify sites, and directed test excavations to evaluate the National Register eligibility of a prehistoric archaeological site. Consulted with Native American tribe and State Historic Preservation Office for Section 106 National Historic Preservation Act compliance on behalf of the Department of Energy.

Regulatory Support Program; Federal Energy Regulatory Commission - Prepared Environmental Impact Statements and Environmental Assessments and conducted agency consultation to ensure compliance with Section 106 of the National Historic Preservation Act for hydroelectric projects in western United States in support of FERC staff. Prepared four major EISs and four EAs for hydroelectric projects in California, Oregon, Washington, Idaho, Nebraska, and Wisconsin. Prepared cultural resources portions of FERC's Licensing Handbook and Relicensing Handbook. Assessed potential effects of licensing or relicensing on large and complex hydroelectric projects and associated irrigation canals, powerhouses, dams, and electric transmission lines. Prepared Memorandum of Agreement between FERC, State Historic Preservation Office, and Advisory Council on Historic Preservation, and managed Section 106 compliance for Star Falls Hydroelectric Project.

Columbia River System Operation Review EIS; Bonneville Power Administration - Prepared an EIS evaluating 21 alternatives for the re-operation of the 14 federal dams on the Columbia and Snake river systems. Analyzed potential effects of project operational alternatives on archaeological sites and Native American traditional cultural properties. Authored computer program to analyze reservoir fluctuation effects on archaeological sites and data analysis chapters of technical appendix to EIS. Participated in multi-party technical working group with 5 federal agencies and 14 Native American tribes to assess regulatory issues and potential effects of re-operation program.

Sutter Energy Center, Calpine Corporation - Project Archaeologist for California Energy Commission Application for Certification for merchant thermal power plant and 30 miles of natural gas and electrical transmission facilities. Planned and conducted cultural resources inventories and prepared license application. Prepared Application for California Energy Commission and cultural resources inventory report to meet Section 106 National Historic Preservation Act requirements for Western Area Power Administration. Prepared Monitoring and Mitigation Plan and supervised construction monitoring of natural gas pipeline.

Benicia Army Cemetery Historic Resources Management Plan; U.S. Army Corps of Engineers - Project Manager for Historic Resources Management Plan and public interpretation plan for Benicia Army Cemetery, the oldest U.S. military post cemetery in the Pacific States. Directed archival research program at National Archives. Prepared an interpretive program for the cemetery.

Publications and Presentations

Davy, D.M. 1999. Early Holocene buried sites in the Tustin Plain. Society for California Archaeology, Sacramento, California.

Davy, D.M., R. Herbert, and J. Carrier. 1998. A Regional and Interservice Approach to Historic Buildings and Structures Evaluation. *Proceedings of the National Defense Industrial Association.*

Davy, D.M. 1995. Simulating reservoir effects on archaeological sites for the Columbia River System Operation Review. Annual Meeting of the Northwest Anthropological Conference.

Davy, D.M. and B.A. Ramos. 1994. A statistical analysis of Gunther Barbed projectile points from two Northern California sites. *Proceedings of the Society for California Archaeology* 7.

Davy, D.M. 1994. River flow regulation as a measure to mitigate the effects of a hydroelectric project on a cultural landscape. Annual meeting of the National Council on Public History.

Davy, D.M. 1980. Borrowed concepts: a comment on Rhoades. *American Antiquity* 45:346-349.

Education

Ph.D., Archaeology, Southern Illinois University, Carbondale, 1982
M.A., Ethnology, Southern Illinois University, Carbondale, 1978
B.A., Anthropology, University of California, Santa Cruz, 1970

Certification

Register of Professional Archaeologists, 1999 (SOPA since 1985)

APPENDIX 8.8B

Records of Conversations with Public Service Providers

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To: Lt. Barry Wong, SFFD
Station #37
Fire Fighter Leo Tingin, SFFD
Station #25
Lt. Chris Reyes, SFFD Station #9

Phone No.: 415.558.3237, 415.558.3225, 415.558.3209

Date: February 01, 2005

Call From: Fatuma Yusuf **Time:** 01:57 PM

Message Taken By:

Subject: Fire Stations closest to the project site

I called the main phone line for the San Francisco Fire Dept (415.558.3200) and asked them which stations were closest to the proposed project site for the SFERP project. I was told that the nearest stations were the following:

Station 9 at 2245 Jerrold Ave./Napolean St.
Station 25 at 3305 3rd St./Marin St.
Station 37 at 789 Wisconsin St./22nd St.

I asked and received the direct phone lines for the above stations.

I spoke to Lt Barry Wong of Station # 37. He told me that the station had one engine company comprising of fire engine manned by 1 officer and 3 firefighters. The response time to an emergency from the project site would be less than 5 minutes. Lt. Wong confirmed that the Station Nos. 9, 37 and 25 were the nearest to the proposed project site with 25 being the closest.

Next, I spoke to Firefighter Leo Tingin of the Station #25. Tingin told me that Station #25 has one engine company comprising of one fire engine, 3 firefighters and one officer. The response time to an emergency from the proposed project site would be less than 5 minutes. Tingin confirmed that Station 25 was the nearest to the proposed project site but thought that we should also include Station No. 7 (located at 2300 Folsom St./19th St.) as the one of the closest stations to the site.

Finally, I spoke to acting Lt. Chris Reyes of Station #9 who told me that the station has one engine company (manned by one officer and 3 firefighters) and one truck company (manned by one officer and 4 firefighters). He too confirmed that the nearest stations to the proposed project site were Stations Nos. 9, 25 and 37 with 25 being the closest. Lt. Reyes disagreed with Firefighter Tingin on the inclusion of Station No. 7.

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To:	Captain Rick Bruce San Francisco PD		Bayview Station 201 Williams Ave
Phone No.:	415-671-2300	**Date:**	February 09, 2005
Call From:	Fatuma Yusuf	**Time:**	09:39 AM
Message Taken By:			
Subject:	San Francisco Electric Reliability Project		

Captain Rick Bruce informed me that the information given to me by Captain Mike Puccinelli last year was still true for the new proposed project site for the SFERP. The only difference is that the Bayview Station now has 130 sworn officers consisting of one is the captain, 4 are lieutenants, 15 are sergeants and the remaining are patrol officers.

From: Brent Lewis [Brent.Lewis@sfgov.org]
Sent: March 03, 2005 10:19 AM
To: Yusuf, Fatuma/SAC
Subject: Fw: Budget Info: San Francisco Electric Reliability Project

FY2002-03

(See attached file: 20050301 - Sacramento EconomicstFY02-03 - Brent.ppt)

Brent Lewis
Sr. Administrative Analyst
Controller's Office
Budget & Analysis Division
554-5247

Brent
Lewis/CON/SFGOV

03/01/2005 12:08
PM

To
<Fatuma.Yusuf@CH2M.com>
cc

Subject
RE: Budget Info: San Francisco
Electric Reliability Project
(Document link: Brent Lewis)

We are working on the FY05-06 right now. The Mayor's proposed budget will be available on 6/1/05 and the final budget will not be available until August. You can send me a follow up e-mail around that time to request FY05-06 data.

Brent Lewis
Sr. Administrative Analyst
Controller's Office
Budget & Analysis Division
554-5247

<Fatuma.Yusuf@CH2
M.com>
To
03/01/2005 12:07 <Brent.Lewis@sfgov.org>
PM cc

Subject
RE: Budget Info: San Francisco
Electric Reliability Project

Brent,

This is GREAT. Thanks! Is the proposed 2005-06 budget out yet? If so, could you send me the same information for FY 2005-06?

Fatuma

-----Original Message-----
From: Brent Lewis [mailto:Brent.Lewis@sfgov.org]
Sent: March 01, 2005 12:01 PM
To: Yusuf, Fatuma/SAC
Subject: Re: Budget Info: San Francisco Electric Reliability Project

Hi,

As requested:

(See attached file: 20050301 - Sacramento Economicst - Brent.ppt)

Brent Lewis
Sr. Administrative Analyst
Controller's Office
Budget & Analysis Division
554-5247

<Fatuma.Yusuf@CH2

M.com>

To

03/01/2005 11:43 <Brent.lewis@sfgov.org>

AM

cc

Subject

Budget Info: San Francisco Electric
Reliability Project

Hi Brent,

As I mentioned to you our recently concluded phone conversation, I'm working on the socioeconomic analysis section of the Application for Certification (AFC) for the proposed San Francisco Electric Reliability Project. This proposed site for the project is in the Potrero Hill area of the city. The California Energy Commission (CEC) requires that all AFCs report and analyze the public finances of the local government. As such we need to report a summary of the City's sources and uses of funds.

As of now, I can pull a summary of the sources of funds from the document " City and County of San Francisco Consolidated Budget and Annual Appropriation Ordinance: Fiscal Year Ending June 30, 2005" but can't find a similar summary for the uses of the funds. The summary of the uses of the funds by category is on p. 16.

I would really appreciate it very much if you could provide me with a summary of the expenditures by category.

As I indicated in my telephone conversation with you, I need this information as soon as possible. The City is planning to file the AFC in the next week and a half week or so and I need to get this information into the document by end of this week, if possible. Please let me know if there's anything I can do from my end to hurry up the process.

Thanking in advance for your help,

Fatuma Yusuf, Ph.D.
Economist
CH2M HILL
2485 Natomas Park Dr. Suite 600
Sacramento, CA 95833-2937
Phone: 916.286.0479
Email: fyusuf@CH2M.com
Facys: 916.614.3484

MessageFrom: Justin Strong [justin@wwstar.com]
Sent: February 02, 2005 7:21 AM
To: Yusuf, Fatuma/SAC
Subject: RE: Number of hotel/motel rooms

Fatuma,

The two counties' information is attached for running 12 months ending Dec 2004.

We do not track cities on a monthly basis. You can have a trend run for a specified number of properties ,though, for $400.

San Francisco County
OCCUPANCY: 70.1 %
ROOM RATE: $ 130.56

San Bernardino County
OCCUPANCY: 68.1 %
ROOM RATE: $ 65.10

Hope this information helps. Please let me know if you have questions.

Thanks.

Justin

-----Original Message-----
From: Fatuma.Yusuf@CH2M.com [mailto:Fatuma.Yusuf@CH2M.com]
Sent: Monday, January 31, 2005 4:21 PM
To: Justin Strong
Subject: RE: Number of hotel/motel rooms

Hi Justin,

I would really appreciate it very much if you could send me the following information for San Francisco County, San Bernardino County, and the City of Grand Terrace:

Room Rate
Occupancy or Vacancy rate

If you could send me the annual data for 2004.

Thanks,

Fatuma

-----Original Message-----
From: Justin Strong [mailto:justin@wwstar.com]
Sent: December 31, 2003 11:42 AM
To: Yusuf, Fatuma/SAC
Subject: RE: Number of hotel/motel rooms

This is the rate and occupancy for San Francisco County from November 2002 to November 2003.

ROOM RATE: $ 138.98
OCCUPANCY: 67.0 %

Let me know if this works.

-----Original Message-----
From: Fatuma.Yusuf@ch2m.com [mailto:Fatuma.Yusuf@ch2m.com]
Sent: Wednesday, December 31, 2003 1:39 PM
To: Justin Strong
Subject: RE: Number of hotel/motel rooms

How about for 2002? Do you happen to also have the vacancy rate for that period?

-----Original Message-----
From: Justin Strong [mailto:justin@wwstar.com]
Sent: December 31, 2003 11:37 AM
To: Yusuf, Fatuma/SAC
Subject: RE: Number of hotel/motel rooms

Are you looking for Year to date or running 12 month?

-----Original Message-----
From: Fatuma.Yusuf@ch2m.com [mailto:Fatuma.Yusuf@ch2m.com]
Sent: Wednesday, December 31, 2003 1:36 PM
To: Justin Strong
Subject: RE: Number of hotel/motel rooms

I forgot to ask in my last email. What year are the stats below for?

Thanks again,

Fatuma

-----Original Message-----
From: Justin Strong [mailto:justin@wwstar.com]
Sent: December 31, 2003 8:20 AM
To: Yusuf, Fatuma/SAC
Cc: Bobby Bowers
Subject: RE: Number of hotel/motel rooms

Fatuma,

We do not track city data in our normal processing, however we can offer you a trend with this info. for $300.

We do track county info. Numbers for San Francisco county are as follows :

Properties: 244
Rooms: 34832
ROOM RATE: $ 139.19

Let me know if you would like the trend or if I can help you with anything else.

Happy Holidays!

Justin

Original Message-----

From: Fatuma.Yusuf@ch2m.com [mailto:Fatuma.Yusuf@ch2m.com]
Sent: Tuesday, December 30, 2003 6:43 PM
To: Justin Strong
Subject: FW: Number of hotel/motel rooms

Hi Justin,

Can you help with this? Thank you so much for your help.

Fatuma

-----Original Message-----
From: Yusuf, Fatuma/SAC
Sent: December 30, 2003 4:41 PM
To: Bobby Bowers (bobby@wwstar.com)
Subject: Number of hotel/motel rooms

Hi Bobby,

Hope you are enjoying the Holidays. If you are able to help, I'd really appreciate it very much if you could send me the following information for the City and County of San Francisco:

Number of hotels/motels
Number of hotels/motel rooms
Average rate hotel/motel room rates.

Thanks and a Wonderful and Prosperous New Year.

Fatuma Yusuf, Ph.D.
Economist
CH2M HILL
2485 Natomas Park Dr. Suite 600
Sacramento, CA 95833-2937
Phone: 916.286.0479
Email: fyusuf@CH2M.com
Facys: 916.614.3484

MessageFrom: Jeff Fillingim-Selk [jfillin@muse.sfusd.edu]
Sent: February 04, 2005 11:48 AM
To: Yusuf, Fatuma/SAC
Subject: RE: Current Enrollment Counts

Hello,

Nancy Waymack in the Superintendent's Office has provided me with projections for the requested schools. She has no projections available district wide and did not indicate that she was working on this (so I don't know if or when they will be available...).

Attached is a revised document.

Peace,

Jeff Fillingim-Selk

Operations Manager, EPC

241-6029 (office)

241-6087 (fax)

-----Original Message-----
From: Fatuma.Yusuf@CH2M.com [mailto:Fatuma.Yusuf@CH2M.com]
Sent: Tuesday, February 01, 2005 2:53 PM
To: jfillin@muse.sfusd.edu
Subject: FW: Current Enrollment Counts

Hi Jeff,

I just left you a voicemail about this issue. I don't know if you remember but I contacted Claudia Beliz (who I believe subsequently contacted you) last year about school enrollment numbers (both current and projected) for the SF school district and for the schools closest to the proposed SFPUC's San Francisco Electric Reliability Project (SFERP). The SFPUC is required by the California Energy Commission (CEC) to prepare an Application for Certification (AFC) for it's proposed power plant that was to be located at corner of Illinois Street and 23rd Street in the Potrero District of the City of San Francisco. The AFC is the equivalent of an environmental impact analysis document. I am helping the SFPUC prepare the socioeconomics section of the supplement to the AFC that was submitted last year to the CEC.

Since the supplemental AFC is being prepared because the location of the project moved from corner of Illinois Street and 23rd Street to an area between Cesar Chavez Street and 25th Street in the Potrero District (I understand that it is going to be behind the Muni building that is being built on Illinois and 25th streets), we need to confirm that the schools nearest to the proposed site are still:

1. Potrero Hill MS

2. Starr King ES

3. Daniel Webster ES

If the schools nearest the proposed project site are still the same, I'd appreciate it very much if you'd provide me with the enrollment numbers for the years indicated in the attached table. If the schools have changed, please let me know which schools are near the proposed project or serve the proposed project site.

Please let me know if this is something that is going to take more than a few days. Please send this information to me as soon as possible via either email or fax. If you need to reach me, please contact me via email or cell phone (916.799.7735).

Thanks in advance for your help,

Fatuma Yusuf, Ph.D.
Economist
CH2M HILL
2485 Natomas Park Dr. Suite 600
Sacramento, CA 95833-2937
Phone: 916.286.0479
Email: fyusuf@CH2M.com
Facys: 916.614.3484

-----Original Message-----
From: Yusuf, Fatuma/SAC
Sent: January 14, 2004 1:39 PM
To: 'Jeff Fillingim-Selk'
Subject: RE: Current Enrollment Counts

Hi Jeff.

Thank you for sending the data. I know you have already told me that the projected data is not easily available. For the time being, the current data will have to suffice. But I'd really appreciate it very much if you'd send me the projected enrollment numbers once you have them.

I noticed that there is a Grade 13 listed in the data you send. The spreadsheet shows 29 students enrolled in Grade 13. What is Grade 13?

Thanks.

Fatuma

-----Original Message-----
From: Jeff Fillingim-Selk [mailto:jfillin@muse.sfusd.edu]
Sent: January 14, 2004 1:17 PM
To: Yusuf, Fatuma/SAC
Subject: Current Enrollment Counts

Hello Fatuma,

Attached is a spreadsheet that approximates the form that you sent to Claudia Beliz. I hope that it is acceptable. I am working on providing you projection numbers. I should have some numbers or a status for you by tomorrow AM, if I don't please don't hesitate to contact me.

The data in the attached document are derived from the student file that was used to report the CBEDS numbers for the Fall, 2003.

I hope that this is helpful.

Peace,

Jeff Fillingim-Selk

Operations Manager, EPC

241-6029 (office)

241-6087 (fax)

APPENDIX 8.12A

Offsite Consequence Analysis

Offsite Consequence Analysis

PREPARED FOR:	John Carrier/CH2M HILL, Ralph Hollenbacher/SFPUC, Jerry Salamy/CH2M HILL, Karen Kubick/SFPUC
PREPARED BY:	William Heung/CH2M HILL, Stephen O'Kane/CH2M HILL
DATE:	February 9, 2005

The City and County of San Francisco (CCSF) is proposing to construct and operate a simple-cycle power plant, the San Francisco Electric Reliability Project (SFERP). The project site is located adjacent to the San Francisco Bay in the Potrero District of the CCSF, between 25th Street and Cesar Chavez Street, southeast of the intersection of Michigan and 25th Street. The site will be adjacent to the proposed MUNI Metro East Light Rail Operations and Maintenance Facility.

The SFERP project will consist of a nominal 145-megawatt (MW) simple-cycle plant, using three natural gas-fired LM 6000 gas turbines and associated infrastructure. The project will include the construction of a new air-insulated 115-kV switchyard on the north side of the site. A natural gas pipeline tie-in will be made to an existing PG&E-owned, natural gas transmission line approximately 800 feet west of the project site. Water for the project will be delivered via a wastewater supply pipeline and treated onsite.

The City is required by both the Clean Air Act (CAA) and the Bay Area Air Quality Management District (BAAQMD) to install Best Available Control Technology (BACT) to control emissions of criteria air pollutants from the combustion turbines. The project's turbines will incorporate water injection to reduce emissions of oxides of nitrogen (NO_X). Carbon monoxide (CO) and volatile organic compounds (VOCs) emissions will be controlled using an oxidation catalyst system. In addition, emissions of NO_X from the turbines will be further reduced through the use of selective catalytic reduction (SCR). The SCR control system uses ammonia as the reduction reagent in the presence of a catalyst. Two forms of ammonia may be used in currently designed SCR systems, i.e., aqueous ammonia or anhydrous ammonia. The City is proposing to use the less toxic form, aqueous ammonia.

The City will store a 29-percent aqueous ammonia solution in a single stationary storage tank. The capacity of the tank will be approximately 12,000 gallons, although no more than 10,000 gallons will be stored. The tank will be surrounded by a secondary containment structure capable of holding the full contents of the tank, approximately 665 square feet (38 feet by 17.5 feet). On the floor of the detention basin, a drain line (24-inch diameter) leads to a spill vault (6 feet by 14 feet by 18 feet).

Aqueous ammonia will be delivered to the plant by truck transport. The truck loading area will be located within a bermed area adjacent to the storage tank. The floor of the loading area will be sloped to drain into the spill vault for the tank through a 4-inch drain line.

Offsite Consequence Analysis

An offsite consequence analysis of a tank failure and subsequent release of aqueous ammonia was prepared. The analysis assumes the complete failure of the tank and the formation of an evaporating pool of aqueous ammonia within the secondary containment structure. For purposes of this analysis, the meteorological data used were the U.S. Environmental Protection Agency's (USEPA's) default (worst case) meteorological data, supplemented by daily temperature data as required by 19 CCR 2750.2.

The SFERP will be located in the Potrero District, San Francisco, California. The maximum temperature recorded near the Potrero District (San Francisco International Airport) in the past 3 years was 97 °F or 309.26 Kelvin (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?casfoa+sfo). Maximum temperatures combined with low wind speeds and stable atmospheric conditions are expected to result in the highest modeled ammonia concentrations at the furthest distance downwind of the project site.

Table 1 displays the meteorological data values used in the modeling analysis.

TABLE 1
Meteorological Input Parameters

Parameter	Worst Case Meteorological Data
Wind Speed, meters/second	1.5
Stability Class	F
Relative Humidity, Percent	50
Ambient Temperature, Kelvin (°F)	309.26 (97 °F)

One modeling run was conducted for an evaporating pool release caused by a single tank failure for the corresponding meteorological scenario listed in Table 1. Modeling was conducted using the SLAB numerical dispersion model. A complete description of the SLAB model is available in *User's Manual for SLAB: An Atmospheric Dispersion Model for Denser-Than-Air Releases, D. E. Ermak, Lawrence Livermore National Laboratory, June 1990.* The SLAB user manual contains a substance database, which includes chemical specific data for ammonia. This data was used in all modeling runs without exception or modification.

Aqueous ammonia release rates were estimated pursuant to guidance documentation[1] and using the "evaporation calculator" provided by the National Oceanic and Atmospheric Administration[2]. The model assumed release rates from an evaporating 29-percent ammonia solution assuming mass transfer across the liquid surface occurs according to principles of heat transfer by natural convection and using the meteorological data displayed in Table 1 and the dimensions of the secondary containment area.

An initial ammonia evaporation rate was calculated (based on the entire contents of the tanks being released in a 10-minute period of time) and assumed to occur for at least one hour. For concentrated solutions, the initial evaporation rate is substantially higher than the rate averaged over time periods of a few minutes or more since the concentration of the solution immediately begins to decrease as evaporation begins.

---

[1] *RMP Offsite Consequence Analysis Guidance, EPA, April 1999*

[2] (http://response.restoration.noaa.gov/cameo/evapcalc/evap.html#)

For the main storage tank scenario, the complete release of the storage tank contents (10,000 gallons of 29-percent aqueous ammonia) was assumed to be the worst case scenario. The failure of the tank would cause the aqueous ammonia to leak into the containment area and the release of ammonia will result from evaporation.

Although the edge of the tank containment area is raised above ground level, the release heights used in the modeling were set at 0 m above ground level (AGL) (i.e., the sump drain is blocked) to maintain the conservative nature of the analysis. Downwind concentrations of ammonia were calculated at heights of 10, 5, and 1.6 meters above ground level and at 0 meters above ground. Reported distances to specified toxic endpoints are the maximum distances for concentrations at 0, 1.6, 5 or 10 meters above ground. The California Office of Environmental Health Hazard Assessment (OEHHA) has designated 1.6 meters as the breathing zone height for individuals. 5 and 10 meters correspond to the heights of a 2 and 3 story building, respectively.

An analysis of the tank loading hose failure with a leak below the excess flow valves activation set-point and the subsequent impacts were considered. This analysis would normally be completed under typical or average meteorological conditions for the area. However, after review of the possible failure modes, it was determined that the impact of this leak would be bracketed by the complete tank failure as a worst-case for the hose failure.

Toxic Effects of Ammonia

With respect to the assessment of potential impacts associated with an accidental release of ammonia, four offsite "bench mark" exposure levels are typically evaluated, as follows: (1) the lowest concentration posing a risk of lethality, 2,000 ppm; (2) the Occupational Safety and Health Administration's (OSHA) Immediately Dangerous to Life and Health (IDLH) level of 300 ppm; (3) the Emergency Response Planning Guideline (ERPG) level of 200 ppm, which is also the RMP level 1 criterion used by the USEPA and California [Note: in the year 2000 the American Industrial Hygiene Association (AIHA) updated the ERPG-2 for ammonia to 150 ppm]; and (4) the level considered by CEC staff to be without serious adverse effects on the public for a one-time exposure of 75 ppm (*Preliminary Staff Assessment-Otay Mesa Generating Project, 99-AFC-5, May 2000).*

The odor threshold of ammonia is about 5 ppm, and minor irritation of the nose and throat will occur at 30 to 50 ppm. Concentrations greater than 140 ppm will cause detectable effects on lung function even for short-term exposures (0.5 to 2 hours). At higher concentrations of 700 to 1,700 ppm, ammonia gas will cause severe effects; death occurs at concentrations of 2,500 to 7,000 ppm.

The specified toxic endpoint (TE) value for ammonia is 0.14 mg/l, which is approximately equal to 200 ppm (*RMP Offsite Consequence Analysis Guidance, EPA, April 1999*). The TE value is based on a one-hour exposure or averaging time, therefore, the modeling concentrations at all offsite receptors will be given in terms of one-hour (or 60 minute) averaging time.

Modeling Results

Table 2 shows the distance to the lowest concentration posing a risk of lethality, (2,000 ppm), OSHA's IDLH (300 ppm), the EPA/CalARP toxic endpoint (200 ppm) and the CEC significance value (75 ppm) for the modeled release scenario. Figure 1 shows the facility and the distance to the 5 ppm, 25 ppm, 75 ppm, 200 ppm, 300 ppm, and 2,000 ppm modeled concentrations.

TABLE 2
Distance to EPA/CalARP and CEC Toxic Endpoints

Scenario	Distance in Meters to 2,000 ppm	Distance in Meters to IDHL of 300 ppm	Distance in Meters to EPA/CalARP TE of 200 ppm	Distance in Meters to CEC Significance Value, 75 ppm	Distance in Meters to CCSF DPH Value, 25 ppm	Distance in Meters to Odor Threshold, 5 ppm
0 m AGL	22.18	25.75	26.19	27.22	29.53	30.49
1.6 m AGL	25.79	29.72	30.13	31.13	33.9	35.00
5 m AGL	35.54	40.02	40.29	41.07	44.97	46.53
10 m AGL	51.72	54.01	54.15	58.77	61.46	62.53

The model input file and the output files are available upon request.

As shown by Figure 1, the distance to the CEC's extremely protective 75 ppm ammonia concentration extends just off the project site's western boundary, which is on the proposed MUNI Operations and Maintenance Center site. Additionally, ammonia concentrations expected to occur to the north, south, and east boundaries would be significantly lower than 75 ppm due to the ammonia storage tanks location at the western side of the project site.

The San Department of Public Health, Hazardous Materials Unified Program Agency (HMUPA) has issued a Regulated Substance Program Guidance that assists sources in compliance with the State and Federal risk management programs. This guidance "strongly encourages stationary sources to use RMP*Comp for the worst case release scenario". Determining the offsite consequence from a release of 10,000 gallons of 29 percent aqueous ammonia assuming an initial ammonia temperature of 77 °F, and a diked area of 665 square feet, the resulting distance to the toxic end point of 200 ppm is 161 meters or 528 feet. The differences between the RMP*Comp and SLAB estimated distances to the 200 ppm endpoint is explained by in EPA's Frequently Asked Questions[3] on the RMP*Comp website as the following:

> "The results you obtain using RMP*Comp may not closely match the results you obtain running the same release scenario in a more sophisticated air dispersion model such as ALOHA or DEGADIS. That's because of a fundamental difference in purpose between those models and RMP*Comp. RMP*Comp is a planning tool, designed to help you to easily identify high-priority hazards at your facility. It makes simple, generalized calculations. In contrast, models like ALOHA and

---

[3] http://yosemite.epa.gov/oswer/ceppoweb.nsf/content/rmp_comp_faq.htm

DEGADIS are intended to give you as accurate an estimate as possible of the extent and location of the area that might be placed at risk by a particular chemical release."

Assessment of the Methodology Used

Numerous conservative assumptions were used in the above analysis of the tank failure. These include the following:

- Modeling and Meteorology
  - Worst-case of a constant mass flow, initial evaporation rate was modeled, whereas in reality the evaporation rate would decrease with time as the concentration in the solution decreases.
  - Worst-case stability class was used, which almost exclusively occurs during nighttime hours, but the maximum ambient temperature of 97°F was used, which would occur during daylight hours.
  - Worst-case meteorology corresponds to nighttime hours, whereas the worst-case release of a tank failure would most likely occur during daytime activities at the power plant. At night, activity at a power plant is typically minimal.

Risk Probability

Accidental releases of aqueous ammonia in industrial use situations are rare. Statistics compiled on the normalized accident rates for RMP chemicals for the years 1994-1999 from *Chemical Accident Risks in U.S. Industry-A Preliminary Analysis of Accident Risk Data from U.S. Hazardous Chemical Facilities, J.C. Belke, September 2000,* indicates that ammonia (all forms) averages 0.017 accidental releases per process per year, and 0.018 accidental releases per million pounds stored per year. Data derived from *The Center for Chemical Process Safety, 1989,* indicates the accidental release scenarios and probabilities for ammonia in general shown in Table 3.

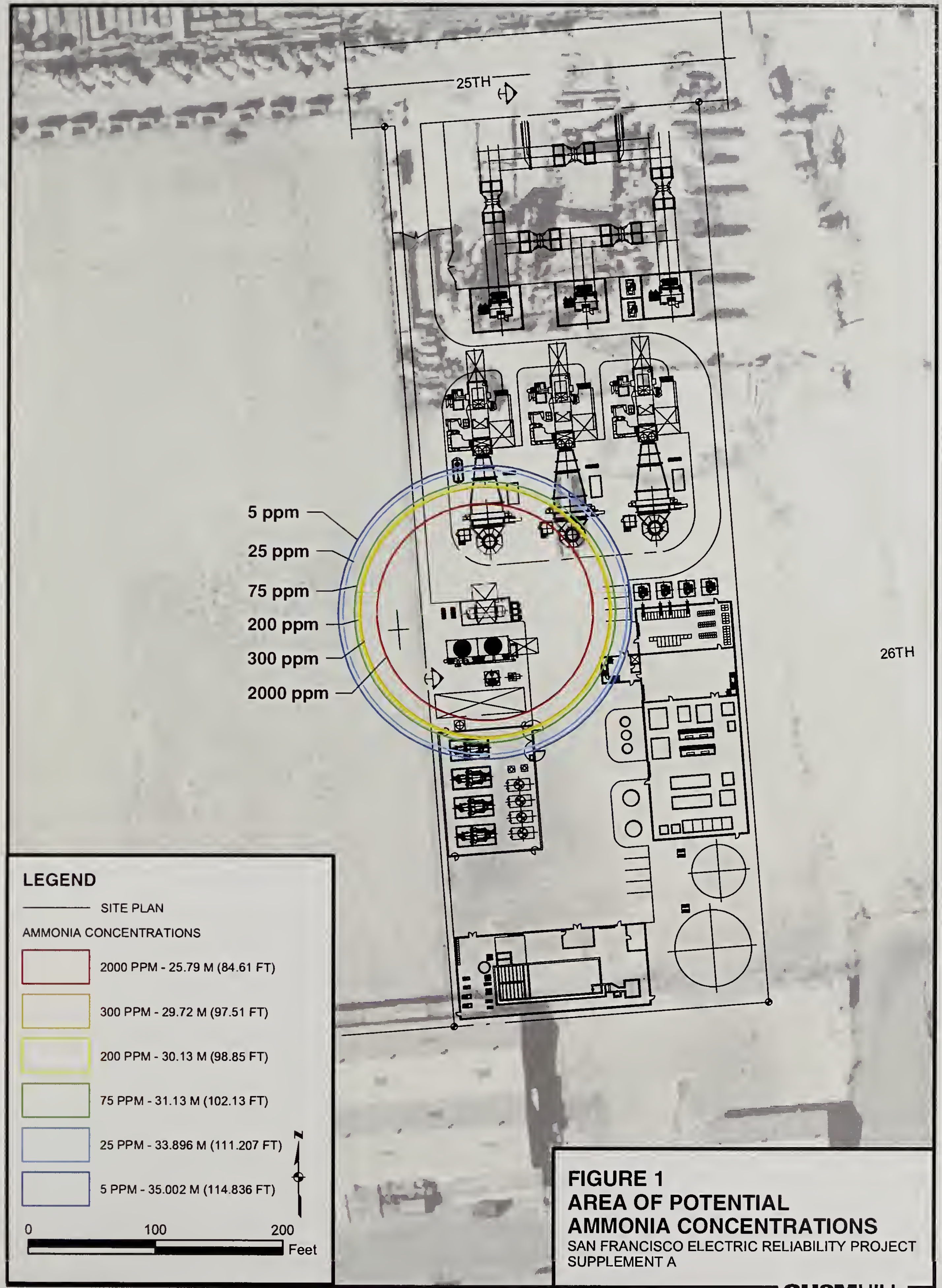
TABLE 3
General Accidental Release Scenarios and Probabilities for Ammonia

Accident Scenario	Failure Probability
Onsite Truck Release	0.0000022
Loading Line Failure	0.005
Storage Tank Failure	0. 000095
Process Line Failure	0.00053
Evaporator Failure	0.00015

Conclusions

Several factors need to be considered when determining the potential risk from the use and storage of hazardous materials. These factors include population densities near the project site, meteorological conditions, and the process design. Considering the results of this analysis, the probability of a catastrophic storage tank failure resulting in the modeled ammonia concentrations, and the probability of a tank failure occurring under low wind speeds and F class atmospheric stability, the risk posed to the local community from the storage of aqueous ammonia at the site is insignificant.

As described above, numerous conservative assumptions have been made at each step in the analysis. This compounding of conservative assumptions has resulted in a significant overestimation of the probability of an ammonia release at the SFERP and the predicted distances to toxic endpoints do not pose a threat to public receptors. Therefore, it is concluded that the risk from exposure to aqueous ammonia due to the SFERP is less than significant.



LEGEND

—— SITE PLAN

AMMONIA CONCENTRATIONS

🟥 2000 PPM - 25.79 M (84.61 FT)

🟧 300 PPM - 29.72 M (97.51 FT)

🟨 200 PPM - 30.13 M (98.85 FT)

🟩 75 PPM - 31.13 M (102.13 FT)

🟦 25 PPM - 33.896 M (111.207 FT)

🟦 5 PPM - 35.002 M (114.836 FT)

0 100 200 Feet

FIGURE 1
AREA OF POTENTIAL AMMONIA CONCENTRATIONS

SAN FRANCISCO ELECTRIC RELIABILITY PROJECT
SUPPLEMENT A

RDD \\LOKI\PROJECTS\RDDGIS\SFPUC\MXDS\AMMONIA_SUPPLEMENTA.MXD AMMONIA_SUPPLEMENTA.PDF 2/23/2005 16:19:15

CH2MHILL

APPENDIX 8.13

Final Risk Management Plan and Site Management Plan

APPENDIX 8.13

Final Risk Management Plan and Site Management Plan

Five hard copies of Appendix 8.13, Final Risk Management Plan and Site Management Plan for the MUNI Metro East Light Rail Vehicle Maintenance and Operations Facility, San Francisco Municipal Railway prepared by AGS, Inc., were submitted to the California Energy Commission. Additional copies will be provided upon request.

APPENDIX 8.15

Final Geotechnical Study Report for the MUNI Metro East Light Rail Vehicle Maintenance and Operation Facility

APPENDIX 8.15

Final Geotechnical Study Report for the MUNI Metro East Light Rail Vehicle Maintenance and Operation Facility

Five hard copies of Appendix 8.15, Final Geotechnical Study Report for the MUNI Metro East Light Rail Vehicle Maintenance and Operation Facility, Volumes 1 and 2, prepared by AGS, Inc., were submitted to the California Energy Commission. Additional copies will be provided upon request.

APPENDIX 10A

Civil Engineering Design Criteria

APPENDIX 10A

Civil Engineering Design Criteria

10A1 Introduction

This appendix summarizes the codes, standards, criteria and practices that will be generally used in the design and construction of civil engineering systems. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement specification and construction specifications as required by the California Energy Commission.

10A2 Codes and Standards

The design of civil engineering systems for the project will be in accordance with the laws and regulations of the federal government, the State of California, and the City and County of San Francisco (CCSF) industry standards. The current issue or edition of the documents at the time of filing of this Application for Certification (AFC) will apply, unless otherwise noted. In cases where conflicts between the cited documents exist, requirements of the more conservative document will be used.

10A2.1 Civil Engineering Codes and Standards

The following codes and standards have been identified as applicable, in whole or in part, to civil engineering design and construction of power plants.

- American Association of State Highway and Transportation Officials (AASHTO) – Standards and Specifications
- American Concrete Institute (ACI) – Standards and Recommended Practices
- American Institute of Steel Construction (AISC) – Standards and Specifications
- American National Standards Institute (ANSI) – Standards
- American Society of Testing and Materials (ASTM) – Standards, Specifications and Recommended Practices
- American Water Works association (AWWA) – Standards and Specifications
- American Welding Society (AWS) – Codes and Standards
- Asphalt Institute (AI) – Asphalt Handbook
- California Building Code (CBC), 2001 (Based on Uniform Building Code (UBC), 1997)
- California Energy Commission – Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California, 1989
- Concrete Reinforcing Steel Institute (CRSI) – Standards

- Factory Mutual (FM) – Standards
- National Fire Protection Association (NFPA) – Standards
- Steel Structures Painting Council (SSPC) – Standards and Specifications

10A2.2 Engineering Geology Codes, Standards and Certifications

Engineering geology activities will conform to the applicable federal, state and local laws, regulations, ordinances and industry codes and standards.

10A2.2.1 Federal

None are applicable.

10A2.2.2 State

The Warren-Alquist Act, PRC, Section 25000 et seq. and the California Energy Commission (CEC) Code of Regulations (CCR), Siting Regulations, Title 20 CCR, Chapter 2, require that Application for Certification (AFC) address the geologic and seismic aspects of the project.

The California Environmental Quality Act (CEQA), PRC 21000 et seq. and the CEQA Guidelines require that potentially significant effects, including geologic hazards, be identified and a determination made as to whether they can be substantially reduced.

10A2.2.3 Local

California State Planning Law, Government Code Section 65302, requires each city and county to adopt a general plan, consisting of nine mandatory elements, to guide its physical development. Section 65302(f) requires that a seismic safety element be included in the general plan.

The project development activities will require certification by a Professional Geotechnical Engineer and a Professional Engineering Geologist during and following construction, in accordance with the CBC, Chapter 33 and Appendix Chapter 33. The Professional Geotechnical Engineer and/or the Professional Engineering Geologist will certify the placement of earthen fills and the adequacy of the site for structural improvements, as follows:

- Both the Professional Geotechnical Engineer and the Professional Engineer will address CBC Appendix Chapter 33, Sections 3309 (Grading Permits), 3312 (Cuts), 3313 (Fills), 3315 (Terraces), 3316 (Erosion Control), and 3318 (Final Report).
- The Professional Geotechnical Engineer will also address CBC Appendix Chapter 33, Sections 3314 (Setbacks) and 3315 (Terraces).

Additionally, the Professional Engineering Geologist will present findings and conclusions pursuant to PRC, Section 25523 (a) and (c); and 20 CCR, Section 1752 (b) and (c).

10A2.3 Storm Drainage Codes, Standards and Certifications

Storm drainage design activities will conform to the applicable federal, state and local laws, regulations, ordinances, and industry codes and standards. The design of all storm drainage will be performed by, or under the direct supervision of, a licensed civil engineer.

10A2.2.1 Federal

All finish floors shall be higher than the 100-year flood plain elevation as established by the Federal Emergency Management Agency.

10A2.2.2 State

None are applicable.

10A2.2.3 Local

The City and County of San Francisco has specific design requirements for storm water management design that will be met by this project.

APPENDIX 10B

Structural Engineering Design Criteria

APPENDIX 10B

Structural Engineering Design Criteria

10B1 Introduction

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used in the design and construction of the structural engineering portions of the project. These criteria form the basis of the design for the structural components and systems of the project. More specific design information will be developed during detailed design to support equipment procurement and construction specifications. Subsection 10B2 summarizes the applicable codes and standards, and Subsection 10B3 includes the general criteria for natural phenomena, design loads, architectural features, concrete, steel, and seismic design. Subsection 10B4 describes the structural design methodology for structures and equipment. Section 10B5 describes the hazard mitigation for the project.

10B2 Design Codes and Standards

The design and specification of work shall be in accordance with all applicable laws and regulations of the federal government, the state of California, and the applicable local codes and ordinances. A summary of the codes and industry standards to be used in the design and construction follows:

- Specifications for materials will generally follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI).
- Field and laboratory testing procedures for materials will follow standard ASTM specifications.
- Design and placement of structural concrete will follow the recommended practices and the latest version of the American Concrete Institute (ACI), the California Building Code, 2001 Edition (CBC, 2001) (based on the Uniform Building Code [UBC] 1997), the San Francisco Building Code, 2001 Edition (SFBC, 2001), and the Concrete Reinforcing Steel Institute (CRSI).
- Design, fabrication, and erection of structural steel will follow the recommended practices and the latest version of the American Institute of Steel Construction Code (AISC), CBC, 2001, and SFBC, 2001.
- Steel components for metal wall panels and roof decking will conform to the American Iron and Steel Institute (AISI) Specification for the Design of Light Gage Cold-Formed Structural Members.
- Welding procedures and qualifications for welders will follow the recommended practices and codes of the American Welding Society (AWS).

- Preparation of metal surfaces for coating systems will follow the specifications and standard practices of the Steel Structures Painting Council (SSPC), National Association for Corrosion Engineers (NACE), and the specific instructions of the coatings manufacturer.
- Fabrication and erection of grating will follow applicable standards of the National Association of Architectural Metals Manufacturers (NAAMM).
- Design and erection of masonry materials will follow the recommended practices and codes of the latest revision of the ACI Concrete Masonry Structures Design and Construction Manual and the International Conference of Building Officials, California Building Code, 2001 Edition (CBC) and SFBC, 2001.
- Design will conform to the requirements of the Federal and California Occupational Safety and Health Administration (OSHA and Cal-OSHA).
- Design of roof coverings will conform to the requirements of the National Fire Protection Association (NFPA) and Factory Mutual (FM).

Other recognized standards will be used where required to serve as guidelines for the design, fabrication, and construction.

10B2.1 Federal

The following laws, ordinances, codes, and standards have been identified as applying to structural design and construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more conservative code will be met.

- Title 29 Code of Federal Regulations, Part 1910, Occupational Safety and Health Standards.
- Walsh-Healy Public Contracts Act (P.L. 50-204.10).

10B2.2 State

The following laws, ordinances, codes, and standards have been identified as applying to structural design and construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more conservative code will be met.

- Business and Professions Code Section 6704, et seq.; Section 6730 and 6736. Requires state registration to practice as a Civil Engineer or Structural Engineer in California.
- Labor Code Section 6500, et seq. requires a permit for construction of trenches or excavations 5 feet or deeper where personnel have to descend. This also applies to construction or demolition of any building, structure, false work, or scaffolding that is more than three stories high or equivalent.
- Title 24 California Code of Regulations (CCR). Adopts current edition of CBC as minimum legal building standards.
- State of California Department of Transportation, Standard Specifications.

- Title 8 CCR Sections 1500, et seq.; Sections 2300, et seq.; and Sections 3200, et seq. Describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.
- Regulations of the following state agencies as applicable.
  - Department of Labor and Industry Regulations.
  - Bureau of Fire Protection.
  - Department of Public Health.
  - Water and Power Resources.
- Title 8 CCR Section 450, et seq. and Section 750, et seq. Adapts American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME B and PVC) and other requirements for unfired and fired boilers.

10B2.3 Industry Codes and Standards

The following laws, ordinances, codes, and standards have been identified as applying to structural design and construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more conservative code will be met.

- California Energy Commission, "Recommended Seismic Design Criteria for Non-Nuclear Power Generating Facilities in California."
- International Conference of Building Officials, "California Building Code" (CBC), 2001 Edition.
- City of San Francisco Building Code, 2001.
- Structural Engineers Association of California, "Recommended Lateral Force Requirements and Commentary," 1999 Recommendation and Commentary.
- Applied Technology Council, "Tentative Provision for the Development of Seismic Regulations for Buildings," (ATC-3-06), Amended December 1982.
- American Institute of Steel Construction (AISC).
  - Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design, June 1, 1989.
  - "Code of Standard Practice for Steel Buildings and Bridges."
  - "Allowable Stress Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
  - Manual of Steel Construction Allowable Stress Design, 9th Edition.
- American Iron and Steel Institute (AISI) "North American Specification for the Design of Cold-Formed Steel Structural Members," 2001. "2002 Edition Cold-Formed Steel Design Manual Parts I-VII."

- American Welding Society (AWS) "Structural Welding Code-Steel Twelfth Edition" (AWS D1.1-2000).
- American Concrete Institute (ACI).
  - "Building Code Requirements for Reinforced Concrete" (ACI 318/318R-02).
  - "Code Requirements for Nuclear Safety Related Structures," Appendix B (Steel Embedments only) (ACI 349-01), except that anchor bolts will be embedded to develop their yield strength.
  - ACI 530-02 "Building Code Requirements for Concrete Masonry Structures."
  - ACI 212.3R-91—Chemical Admixtures for Concrete.
  - ACI 302.IR-96—Guide for Concrete Floor and Slab Construction.
  - ACI 350R-01—Environmental Engineering Concrete Structures.
- Structural and Miscellaneous Steel.
  - ASTM A569/A569M Specifications for Steel Carbon (0.15 maximum percent) Hot-Rolled Sheet and Strip, Commercial Quality.
  - ASME/ANSI STS-1-1986—Steel stacks, except for circumferential stiffening which shall be in accordance with British Standard 4076—1978 and except that seismic design shall be in accordance with CBC 2001.
- American Society for Testing and Materials (ASTM). The current versions of the following codes and standards shall be included as a minimum:
  - ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
  - ASTM A53—Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - ASTM A276—Specification for Stainless Steel Bars and Shapes.
  - ASTM A500—Specification for Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - ASTM B695—Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - ASTM A307—Specification for Carbon Steel Bolts and Studs.
  - ASTM A123—Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
  - ASTM A153—Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - ASTM A82-A—Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - ASTM A185—Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

  - ASTM A 615/A615 M-Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- Masonry Institute of America, "Reinforced Masonry Engineering Handbook."
- American Water Works Association (AWWA).
  - "Standards for Welding Steel Tanks," (AWWA D100-96).
  - "Standards for Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids" (AWWA C301-99).
  - "Standards for Reinforced Concrete Water Pipe—Noncylinder Type, Not Prestressed" (AWWA C302-95).
- American Association of State Highway and Transportation Officials—(GDHS-2), "A Policy on Geometric Design of Highways and Streets."
- Heating, Ventilating, and Air Conditioning Guide by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
- Uniform Plumbing Code (UPC), 2000 Edition.
- International Association of Plumbing and Mechanical Officials.
- National Fire Protection Association Standards (NFPA).
- Steel Structures Painting Council Standards (SSPC).
- American Society of Nondestructive Testing (SNT-TC-1A).
- International Standard Organization (ISO) 3945-85 "Mechanical Vibration of Large Rotating Machines with Speed Range from 10 to 200 revs/sec—Measurement and Evaluation of Vibration Severity In Situ."

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents. Where no other standard or code governs, the CBC will be used. In the event of conflict between referenced codes, standards, and design criteria, the more restrictive condition shall apply.

10B3 Structural Design Criteria

10B3.1 Natural Phenomena

10B3.1.1 Datum

The finished grade of the facility will be approximately 10 to 15 feet above MSL.

10B3.1.2 Wind Speed

The design wind speed will be 80 miles per hour based on CBC, 2001 edition for a 50-year recurrence interval. This design wind speed will be used to determine wind loads for all structures as discussed in Subsection 10B3.2.3 Wind Loads.

10B3.1.3 Temperature

The design basis temperatures for Civil and structural systems will be as follows:

Maximum	108°F
Minimum	25°F

10B3.1.4 Frost Penetration

The site is located in an area free of frost penetration. Bottom elevation of all foundations for structures and equipment, however, will be maintained at a minimum of 1 inch below the finished grade.

10B3.1.5 Seismicity

The plant site is located in Seismic Zone 4, as determined from Figure No.16-2, "Seismic Zone Map of the United States," of CBC, 2001.

10B3.1.6 Snow

The plant site is located in a zero ground snow load area, as determined from Figure No. A-16-1 of CBC, 2001.

10B3.2 Design Loads

Design loads for all structures will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

10B3.2.1 Dead Loads

Dead loads will consist of the weights of the structure and all equipment of a permanent or semi-permanent nature including tanks, bins, wall panels, partitions, roofing, piping, drains, electrical trays, bus ducts, and the contents of tanks and bins measured at full operating capacity. The contents of tanks and bins shall not be considered as effective in resisting column uplift due to wind forces but shall be considered effective for seismic forces.

10B3.2.2 Live Loads

Live loads will consist of uniform live loads and equipment live loads. Uniform live loads are assumed unit loads which are sufficient to provide for movable and transitory loads, such as the weight of people, portable equipment and tools, planking and small equipment, or parts which may be moved over or placed on floors during maintenance operations. These uniform live loads shall not be applied to floor areas which will be permanently occupied by equipment.

Equipment live loads are calculated loads based upon the actual weight and size of the equipment and parts to be placed on floors during dismantling and maintenance, or to be temporarily placed on or moved over floors during installation.

Uniform live loads will be in accordance with CBC, 2001, but will not be less than the following:

a. **Roofs: 20 psf.** All roof areas will be designed for wind loads as indicated in Subsection - B3.2.3, Wind Loads. Ponding loading effect because of roof deck and framing deflections will be investigated in accordance with AISC Specification Article K2. All roof areas will be designed for a minimum of 20 psf live load in addition to calculated dead loads.

b. **Floors and Platforms (Steel grating and checkered plate): 100 psf.** In addition, a uniform load of 50 psf will be used to account for piping and cable tray, except where the piping and cable tray loads exceed 50 psf, the actual loads will be used. Pipe hanger loads for the major piping systems will be specifically determined and located. Piping expansion and dynamic loads will be considered on an individual basis for their effect on the structural systems. Loads imposed on perimeter beams around pipe chase areas will also be considered on an individual basis.

c. **Floors (Elevated Concrete Floors): 125 psf.** In addition, elevated concrete slabs will be designed to support an alternate concentrated load of 3 kips in lieu of the uniform loads, whichever governs. The concentrated load will be treated as a uniformly distributed load acting over an area of 2.5 square feet, and will be located in a manner to produce the maximum stress conditions in the slab.

d. **Control Room Floor: 150 psf.**

e. **Stairs, Landings and Walkways: 100 psf**. In addition, a concentrated load of 2 kips will be applied concurrently to the supporting beams for the walkways to maximize the stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

f. **Pipe Racks: 100 psf**. Where the piping and cable tray loads exceed the design uniform load, the actual loads will be used. In addition, a concentrated load of 15 kips will be applied concurrently to the supporting beams for the walkways to maximize the stresses in the members, but the reactions from the concentrated loads will not be carried to the columns.

g. **Hand Railings**. Hand railings will be designed for either a uniform horizontal force of 50 plf applied simultaneously with a uniform vertical live load of 100 plf or a 200 pound concentrated load applied at any point and in any direction, whichever governs.

h. **Slabs on Grade: 250 psf.** Consideration will be given to designing appropriate areas of the ground floor for support of heavy equipment such as construction and maintenance cranes.

i. **Truck Loading Surcharge Adjacent to Structures: 250 psf.**

j. **Truck Support Structures: AASHTO-HS-20-44.**

k. Special Loading Conditions: Actual loadings. Laydown loads from equipment components during maintenance and floor areas where trucks, forklifts or other transports have access will be considered in the design live load.

Live loads may be reduced in accordance with the provisions of CBC Section 1607.

Posting of the floor load capacity signs for all roofs, elevated floors, platforms, and walkways will be in compliance with the OSHA Occupational Safety and Health Standard, Walking and Working Surfaces, Subpart D. Floor load capacity for slabs on grade will not be posted.

10B3.2.3 Wind Loads

Wind loads for all structures will be based on CBC, 2001. Basic wind speed shall be 80 miles per hour and wind stagnation pressure (qs) of 16.4 psf. A step function of pressure with height under Exposure C conditions will be used. The Importance Factor shall equal 1.0. Height brackets and velocity pressures are shown in Table 10B-1.

TABLE 10B-1
Height Brackets and Velocity Pressures

Height Bracket (feet aboveground)	Velocity Pressure (pounds-force per square foot)
Grade to 20	18.5
20 to 40	21.5
40 to 60	23.5
60 to 100	26.4
100 to 160	29.4
160 to 200	30.7

The velocity pressures indicated in Table 10B-1 are average values for the indicated height brackets. The design wind pressures will be determined by multiplying the velocity pressures by the appropriate pressure coefficients given in CBC Table No. 16-H using Method 1.

If wind design governs, the detailing requirements and limitations in the CBC, 2001 seismic provisions will also be followed.

10B3.2.4 Steel Stacks

The steel stack and supports shall be capable of enduring specified normal and abnormal design operating conditions in combination with high wind or seismic event for the design life of the facility. Effects of wind will include along-wind and across-wind response. The design will address the design considerations, meet the requirements, and utilize the design methods of Steel Stacks, ASME/ANSI STS-1-1986, and AISC Manual of Steel Construction Allowable Stress Design, Ninth Edition, except that increased allowable stresses for wind will not be used. Design values for yield strength and modulus of elasticity of the stack material will depend on the composition of the material and the maximum temperature of the metal at design operating conditions, and will be as prescribed by the ASME Pressure Vessel Code, Section VIII, Division 2, Part AM. Seismic loads shall be in accordance with CBC 2001.

10B3.2.5 Seismic Loads

Seismic loads will be determined in accordance with the requirements specified in Section 10B3.6, Seismic Design Criteria.

10B3.2.6 Construction Loads

The integrity of the structures will be maintained without use of temporary framing struts or ties and cable bracing insofar as possible. However, construction or crane access considerations may dictate the use of temporary structural systems.

10B3.2.7 Earth Pressures

Earth pressures will be in accordance with the recommendations contained in the project-specific "Final Geotechnical Investigation and Foundation Report."

10B3.2.8 Groundwater Pressures

Hydrostatic pressures due to groundwater or temporary water loads will be considered.

10B3.2.9 Special Considerations for Structures and Loads During Construction

For temporary structures, or permanent structures left temporarily incomplete to facilitate equipment installations, or temporary loads imposed on permanent structures during construction, the allowable stresses may be increased by 33 percent.

Structural backfill may be placed against walls, retaining walls, and similar structures when the concrete strength attains 80 percent of the design compressive strength (f'c), as determined by sample cylinder tests. Restrictions on structural backfill, if any, will be shown on the engineering design drawings.

Metal decking used as forms for elevated concrete slabs, will be evaluated to adequately support the weight of concrete plus a uniform construction load of 50 psf, without an increase in allowable stresses.

10B3.2.10 Load Combinations

At a minimum, the following load combinations will be considered. Applicable CBC, 2001 prescribed load combinations will also be considered:

- Dead load.
- Dead load plus live load plus all loads associated with normal operation of the equipment, e.g., temperature and pressure loads, piping loads, normal torque loads, impact loads, etc.
- Dead load plus live load plus all loads associated with normal operation plus wind load.
- Dead load plus live load plus all loads associated with normal operation plus seismic load.

- Dead load plus construction loads.
- Dead load plus live load plus emergency loads.
- Dead load plus wind load.
- Dead load plus seismic load.

Every building component shall be provided with the strength adequate to resist the most critical effect resulting from the following combination of loads:

- Dead plus floor live plus roof live.
- Dead plus floor live plus wind.
- Dead plus floor live plus seismic.
- Dead plus floor live plus wind plus roof live/2.
- Dead plus floor live plus roof live plus wind/2.
- Dead plus floor live plus roof live plus seismic.

Note: Use live load only where required by CBC, 2001 in combination with seismic.

10B3.2.11 Allowable Stresses

Each load combination shall not exceed the allowable stress permitted by the appropriate code for that combination.

The 1997 UBC/2001 CBC allows a 33 percent stress increase for seismic and wind design in Section 1612.3.2 which specifies loading combinations to be used for the design of structures and portions thereof when using the allowable stress design method. These combinations are permitted a one-third increase in allowable stresses for all combinations including wind or seismic. The design of steel structures will utilize these combinations along with the special seismic load combinations specified in Section 1612.4. Section 1612.3.1, which does not allow a 33 percent stress increase for seismic and wind design of structures, specifies loading combinations to be used for the design of structures and portions thereof, will not be used. Therefore, the load combinations of section B3.2.11.2 (steel design) will comply with the UBC/CBC design requirements. Additionally, welded, bolted, or other intermittent connection such as inserts for anchorage of nonstructural components will not use the one-third increase in allowable stress when considering wind and seismic forces.

10B3.2.11.1 Concrete Structures. For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with CBC Section 1909.

The required strength (U) shall be at least equal to the following:

- U = 1.4 Dead + 1.7 Live
- U = 0.75 (1.4 Dead + 1.7 Live + 1.7 Wind)
- U = 0.9 Dead + 1.3 Wind
- U = 1.4 (Dead + Live + Seismic)
- U = 0.9 Dead + 1.4 Seismic

- U = 1.4 Dead + 1.7 Live + 1.7 Earth Pressure
- U = 0.9 Dead + 1.7 Earth Pressure

10B3.2.11.2 Steel Structures. The required strength (S) based on the elastic design methods and the allowable stresses (Fs) defined in Part 1 of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings is as follows:

- S = Dead + Live + (Roof Live Load)
- S = Dead + Live + (Wind or Earthquake/1.4)
- S = Dead + Live + Earthquake/1.4
- S = 0.9 Dead + Earthquake/1.4

Frame members and connections will conform to the additional requirements of CBC Sections 1633 and 2213.

10B3.3 Architecture

General design criteria for the architectural systems are as follows.

10B3.3.1 Architecture—Engineered Buildings

General design criteria for materials and installation of architectural systems or components will be as follows:

- **Interior Walls.** Where durability is required, interior walls may be constructed of concrete block masonry, structurally designed and reinforced as required. In offices, shops, etc., metal studs with gypsum board will usually be used to form interior partitions. Insulation for sound control will be used where required by design.

- **Fire Exits.** Fire exits will be provided at outside walls as required by code. Exit signs will be provided. Fire doors will bear an Underwriters' Laboratories certification level for class of opening and rating for door, frame, and hardware. Doors will conform to wood or hollow metal door requirements and have fillers adequate to meet the fire rating.

- **Large Access Exterior Doors**. Large access exterior doors will be rolling steel type with weather seals and windlocks. Components will be formed from galvanized steel, factory primed, and field painted. Doors will be motor-operated with override manual operation.

- **Painting**. Exterior steel material that is not galvanized or factory finished will be painted. Painted color will match or harmonize with the color of the exterior face of the wall panels.

- **Color Schemes**. Color schemes will be selected for overall compatibility.

10B3.3.2 Architecture—Prefabricated Metal Buildings

Prefabricated metal buildings (packaged to include exterior doors, wall louvers, windows, and related enclosure components) will be furnished as follows:

- **Building Enclosure**. Building enclosures will be of manufacturer's standard modular rigid frame construction with tapered or uniform depth rafters rigidly connected at ends to pinned-base tapered or uniform depth columns. Purlins and girts will be cold-formed

"C" or "Z" sections conforming to "Specifications for Design of Cold-Formed Steel Structural Members" of American Iron and Steel Institute. All other members will be of ASTM A36 hot rolled shapes conforming to "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" of American Institute of Steel Construction. Roof slopes will be approximately 1-inch rise per 12 inches of run. Metal roof coverings will be of prefinished standing seam panels of 24-gauge minimum.

- **Steel**. Cold-formed components will conform to ASTM A570, Grade E, 42,000 psi minimum yield for material thicknesses equal to or less than 0.23 inch, or to ASTM A375, 50,000 pounds per square inch (psi) minimum yield for high tensile strength purlin or girt sections with material thicknesses equal to or less than 0.23 inch. Roof covering and wallcovering will conform to ASTM A446, Grade A, galvanized 33,000 psi minimum yield. All cold-formed components will be manufactured by precision roll or break forming.

10B3.4 Concrete

Reinforced concrete structures will be designed in accordance with CBC 2001 and ACI 318-02, Building Code Requirements for Reinforced Concrete.

10B3.4.1 Materials

The materials described below will be specified and used as a basis for design:

- **Reinforcing Steel**. Reinforcing steel shall meet the requirements of ASTM A615 Grade-60. Welded wire fabric for concrete will conform to ASTM A185.

- **Cement**. Cement used in all concrete mixes will be portland cement meeting the requirements of ASTM C150.

- **Aggregates**. Fine aggregates will be clean natural sand. Coarse aggregates will be crushed gravel or stone. All aggregates shall meet the requirements of ASTM C33.

- **Admixtures**. Plasticizers and retarders will be used to control setting time and to obtain optimum workability. Air entrainment of 4 to 6 percent by volume will be used in all concrete mixes. Calcium chloride will not be permitted. Interior slabs to be trowel finished may use less air entrainment.

- **Water.** Clean water of potable quality shall be used in all concrete.

10B3.4.2 Design

The system of concrete and steel reinforcing strength combinations will be used as follows:

- **Concrete strength.** See Table 10B-2.
- **Reinforcing strength.** 60,000 psi, Grade 60.

10B3.4.3 Mixes

The design compressive strength (f'c) of concrete and grout, as measured at 28 days, is shown in Table 10B-2.

TABLE 10B-2
The Design Compressive Strength of Concrete and Grout as Measured at 28 Days

Electrical ductbank encasement and lean concrete backfill (Class L-1)	2,000 psi
Structural concrete (Class S-1)	3,000 psi
Structural concrete (Class S-2)	4,000 psi
Grout (Class G-1)	5,000 psi

10B3.4.4 Concrete Tests

Quality control testing of concrete will be performed by an independent laboratory and will consist of the following:

- **Preliminary Review.** Before concrete mixes are designed, the source and quality of materials will be determined and the following reports will be submitted:
  - The type, brand, manufacturer, composition, and method of handling (sack or bulk) of cement.
  - The type, source, and composition of fly ash.
  - The classification, brand, manufacturer, and active chemical ingredients of all admixtures.
  - The source of coarse aggregates and test reports to verify compliance with ASTM C33.
  - The source of fine aggregates and test reports to verify compliance with ASTM C33.
  - The results of tests to determine compliance of admixtures with appropriate ASTM requirements.
- **Design Mix Tests.** Concrete will be proportioned to provide an average compressive strength as prescribed in CBC 2001 Section 1905.3. Documentation that proposed concrete proportions will produce an average compressive strength equal to or greater than required average compressive strength will be established based on trial mixtures in accordance with CBC Section 1905.3.3.
- **Field Control Tests.** Field control tests will include the following.
  - **Aggregate gradation**. Each 500 tons of fine aggregate and each 1,000 tons of coarse aggregate will be sampled and tested in accordance with ASTM D75 and C136.
  - **Slump**. A slump test will be made from each of the first three batches mixed each day. An additional test will be made for each 50 cubic yards placed in any one day.
  - **Air content**. An air content test will be made from one of the first three batches mixed each day and from each batch of concrete from which compression test cylinders are made. Air content tests will be in accordance with ASTM C231.

- **Compression tests.** One set of four concrete test cylinders will be made each day from each class of concrete being placed. Additional sets will be made depending on the amount of concrete placed each day. For each additional 100 cubic yards of each class, or major fraction thereof, placed in any one day, four additional sets of cylinders will be made. One cylinder of each set will be tested at an age of seven days, two cylinders of each set will be tested at 28 days, and one cylinder shall be stored until otherwise directed. Compression tests will be in accordance with ASTM C39.

10B3.4.5 Reinforcing Steel Test

Mill test reports certifying that reinforcing steel is in accordance with ASTM and project specifications will be required.

10B3.5 Steel and Other Metals

10B3.5.1 Structural Steel

Steel framed structures will be designed in accordance with the CBC 2001 and the AISC Specification for the Structural Steel Building, Allowable Stress Design and Plastic Design, June 1, 1989. In addition, steel framed structures will be designed in accordance with the criteria discussed in the following subsections.

10B3.5.1.1 Materials. Structural steel shapes, plates, and appurtenances for general use will conform to ASTM A36 or A 572. Structural steel required for heavy framing members may consider the use of ASTM A441. Structural steel required for tubes will conform to ASTM A500, Grade B. Connection bolts will conform to ASTM A325. Connections will conform to AISC Specification for Structural Joints. Welding electrodes will be as specified by the AWS. All structural steel will be shop primed after fabrication. Exterior structural steel may be hot dipped galvanized in lieu of prime painted.

10B3.5.1.2 Tests. Mill test reports or reports of tests made by the fabricator will be required certifying that all material is in conformance with the applicable ASTM specification. In addition, the fabricator will provide an affidavit stating that all steel specified has been provided at yield stresses in accordance with the drawings and the specification.

10B3.5.1.3 Design. All steel framed structures will be designed as "rigid frame" (AISC Specification Type 1) or "simple" space frames (AISC Specification Type 2), utilizing single span beam systems, vertical diagonal bracing at main column lines, and horizontal bracing at the roof and major floor levels. The use of Type 1 rigid frames will generally be limited to one-story, open garage, warehouse or shed-type structures, or to prefabricated metal buildings.

Suspended concrete slabs will be considered as providing horizontal stability by diaphragm action after setup and curing. Deflections of the support steel will be controlled to prohibit "ponding" of the fresh concrete as it is placed. Metal roof decks attached with welding washers or fasteners may be considered to provide a structure with lateral force diaphragm action. Grating floors will not be considered as providing horizontal rigidity.

Connections will be in accordance with AISC standard connection design for field bolted connections. Connections will be designed with bolts for bearing type joints with threads in shear plane except where connections are required to be slip-critical. Larger diameter bolts may be used to develop larger capacity connections or elsewhere as determined by the engineer.

10B3.6 Seismic Design Criteria

This section provides the general criteria and procedures that will be used for seismic design of structures, equipment, and components.

The project site is located in Seismic Zone 4 according to the California Building Code, 2001 edition. The seismic performance objectives for this facility are as follows:

- Resist minor levels of earthquake ground motion without damage.
- Resist moderate levels of earthquake ground motion without structural damage, but possibly experience some nonstructural damage.
- Resist major levels of earthquake ground motion without collapse, but possibly with some structural as well as nonstructural damage.

To achieve these objectives and to meet the requirements of the CEC and local codes, the facility will be designed in accordance with the 2001 edition of the California Building Code. All structures, equipment internals, and components will be separated from adjoining structures.

10B.3.6.1 Buildings and Structures

The seismic zone used for this site will be Zone 4 as determined from CBC, 2001 Figure No. 16-2 titled “Seismic Zone Map of the United States,” using an Importance Factor of 1.00. Seismic loading will be used in the design of structures only when it is greater than the computed wind loads.

Non-building structures are to be designed in accordance with CBC, 2001 Section 1634. These are typically regular structures as defined in the CBC, so the static lateral force procedure will be applicable. In the event that dynamic analysis will be required based on discussions with the CBO, the affected structures will be evaluated in accordance with the requirements of the CBC.

Buildings and structures defined by CBC, 2001 Section 1629.8.3 will be designed using the static lateral force procedure of Section 1630.

Buildings and structures defined by CBC, 2001 Section 1629.8.4 will be designed using the dynamic lateral force procedure of Section 1631. The ground motion representation will use the response spectrum indicated in CBC Figure 16-3.

Lateral forces on elements of structures and nonstructural components will be determined from the greater of CBC 1632.2 requirements, or CBC 1634.5 requirement for equipment supported laterally at or below grade.

Steel framed structures will comply with the requirements of CBC Chapter 22, Section 2213 including the requirements of Section 2213.5.1

Water storage tanks will meet the seismic design requirements of AWWA D100, Section 13, and CBC 1634.

10B4 Structural Design Methodology

This section describes the structural aspects of the design of the proposed facility. Each major structural component of the plant is addressed by defining the design criteria and analytical techniques that will be employed.

10B4.1 Structures

10B4.1.1 Combustion Turbine Foundations

The combustion turbine foundations will be designed to support the turbine and generator components.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.1.1.1 Foundation Loads. Foundation loads will be furnished by the combustion turbine manufacturer and will be superimposed with loads for the foundation itself. Typical loading data supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads from project specific criteria
- Seismic loads from project specific criteria
- Hydrostatic loads
- Temperature and pressure loads
- Dynamic operating loads
- Emergency loads such as turbine accident loads

10B4.1.1.2 Induced Forces. The combustion turbine and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts or sleeved through-bolts designed to resist the equipment forces.

10B4.1.1.3 Structural Criteria. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Subsection 10B3.4, Concrete. The foundation system will likely be a rigid mat supported on short piles or drilled caissons could be used. Final foundation system selection by the project geotechnical engineers will be based on specific test drillings at the major foundations upon completion of demolition..

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Pile capacities
- Allowable settlements
- Soil liquefaction potential
- Equipment, structure, and environmental loads
- Natural frequencies of rotating equipment

- Access and maintenance
- Equipment performance criteria
- Dynamic effects of the rotating machinery

Environmental loading will be determined in accordance with, Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads.

Seismic loading to the foundation from the combustion turbine will be calculated using equivalent lateral forces applied at the center-of-gravity of the equipment in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria for rigid equipment.

Load combinations and their respective strength factors for the foundation design will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.1.1.4 Analytical Techniques. The combustion turbine foundation will be designed using static analysis techniques assuming a pile supported rigid mat. The mat will be sized such that the allowable settlement and bearing pressure/pile capacity criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed as a combined footing assuming a linear vertical pressure distribution that is taken by the pile group. Pile loads shall be checked locally. The mat will be proportioned such that the resultant of the pile loads coincides as nearly as possible with the resultant of the vertical loading. The mat shall be reinforced to act as a pile cap spanning between piles. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively. The factor of safety on the pile shall be determined by the geotechnical engineer.

The combustion turbine foundation will be checked for dynamic response of the operating combustion turbine. Manual calculations and simple computer models based on the fundamental principles of dynamic behavior of structures will be used to determine the natural frequencies of the support system. Where soil-structure interaction effects are important, low strain soil properties will be used to calculate soil springs using the procedures from Vibrations of Soils and Foundation by Richard, Hall, and Woods or a similar procedure. The concrete foundation will be analyzed as a rigid body on soil springs with the equipment modeled as a rigid mass located at its center of gravity and rigidly attached to the foundation. The foundation will be proportioned such that the principal natural frequencies will be at least 10 percent removed from the equipment operating speed.

Should the resulting foundation design prove to be uneconomical, the dynamic behavior of the foundation will be evaluated and compared to ISO 3945 Criteria for Vibration Severity. The resultant vibration level will be within the "Good" range of this standard.

A procedure for the dynamic analysis of large fan foundations supported by soil or piers, may be used to evaluate the dynamic behavior of the turbine foundations.

10B4.1.2 Exhaust Duct and CO/SCR Foundation

The exhaust duct and CO/SCR foundation will be designed to support the exhaust duct and CO/SCR catalyst structures and associated equipment.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.1.2.1 Foundation Loads. Foundation loads will be furnished by the exhaust duct manufacturer and will be superimposed with loads for the foundation itself. Typical loading data supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Hydrostatic loads
- Temperature and pressure loads

The exhaust duct and CO/SCR foundation will be designed to resist a superimposed uniform live load of 250 psf over the area not otherwise occupied by equipment.

10B4.1.2.2 Induced Forces. The exhaust duct and CO/SCR and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist the equipment forces.

10B4.1.2.3 Structural Criteria. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section B3.4, Concrete. The foundation system will likely be a rigid mat supported on piles or drilled caissons. Final foundation system selection by the project geotechnical engineers will be based on specific test drillings at the major foundations upon completion of demolition.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Pile capacities
- Allowable settlements
- Soil liquefaction potential
- Equipment, structure, and environmental loads
- Access and maintenance
- Equipment performance criteria

Environmental loading will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads.

Seismic loading to the foundation will be supplied by the exhaust duct manufacturer and will reflect the structural system used by the exhaust duct to resist lateral loading.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.1.2.4 Analytical Techniques

The exhaust duct and CO/SCR foundation will be designed using static analysis techniques assuming a pile supported rigid mat. The mat will be sized such that the allowable settlement and bearing pressure/pile capacity criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed as a combined footing assuming a linear vertical pressure distribution that is taken by the pile group. Pile loads shall be checked locally. The mat will be proportioned such that the resultant of the pile loads coincides as nearly as possible with the resultant of the vertical loading. The mat shall be reinforced to act as a pile cap spanning between piles. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively. The factor of safety on the pile shall be determined by the geotechnical engineer.

10B4.1.3 Stack and Foundation

The stacks will be carbon steel stacks supported on a reinforced concrete mat foundation. The height of the stacks will be approximately 85 feet and each will be 12 feet in diameter.

10B4.1.3.1 Foundation Loads. Foundation loads will be determined using project specific design criteria.

The design of the stack and foundation will include the following loads:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads

Foundation loading magnitudes cannot be determined until specific stack design is completed.

10B4.1.3.2 Induced Forces. The stack will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist the foundation and stack induced forces.

10B4.1.3.3 Structural System. The steel stack will resist lateral loading as a fixed base cantilevered structure.

10B4.1.3.4 Structural Criteria. The predominate forces acting on the stack will result from wind or seismic loading. The stack will be designed as indicated in Subsection 10B3.2.4, Steel Stacks.

Seismic loads will be determined in accordance with CBC Section 1634 Nonbuilding Structures. The fundamental period will be determined using CBC equations and will be calculated by both considering and ignoring the structural contribution of any lining material. The lower period will be used in the development of the seismic forces.

The allowable longitudinal stress, F, for the design of the stack shell will be determined from the following equations from ASME/ANSI STS-1-1986.

F = 1/8 Et/r/FS for $t/r < 8Fp/E$

F = [Fy - Ks (Fy - Fp)] / FS for $t/r > 8Fp/E$

$< 20Fy/E$

F = Fy/FS for $t/r > 20Fy/E$

where

E = Steel modulus of elasticity,
t = Shell plate thickness with corrosion allowance,
r = Shell radius,
FS = Factor of safety equal to 1.5,
Fy = Steel yield stress, and
Fp = Steel proportional limit equal to 0.70 Fy.

$$Ks = \left[\frac{\dfrac{20Fy}{E} - \dfrac{t}{r}}{\dfrac{20Fy}{E} - \dfrac{8Fp}{E}}\right]^2$$

The minimum shell thickness will be 0.25 inch plus 0.0625 inch corrosion allowance. The corrosion allowance will be considered in the generation of seismic loads but not in the resistance to seismic or wind loads. Allowable stresses for stiffeners, platform members, and other details will be in accordance with the *American Institute of Steel Construction Allowable Stress Design, Ninth Edition*. Allowable stresses for the shell will not be increased for wind or seismic loadings.

The stack will likely be supported using an octagonal, circular or square shaped reinforced mat footing. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Subsection 10B3.4, Concrete. The foundation system will likely be a rigid mat supported on piles, or drilled caissons could be used. Final foundation system selection by the project geotechnical engineers will be based on specific test drillings at the major foundations upon completion of demolition.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Pile capacities
- Allowable settlements
- Soil liquefaction potential
- Structure and environmental loads

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.1.3.5 Analytical Techniques. Moments, shears, and axial forces will be calculated using static analysis procedures on a cantilevered member. Longitudinal stresses resulting from axial loads and flexure will be combined and compared to a single allowable stress.

The stack foundation will be designed using static analysis techniques assuming a pile supported rigid mat. The mat will be sized such that the allowable settlement and bearing pressure/pile capacity criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads while maintaining a minimum 2.5 factor of safety against overturning. The factor of safety against sliding will be a minimum of 1.5.

10B4.1.4 Buildings

The various plant site buildings will provide support, enclosure, protection, and access to the systems contained within its boundaries.

10B4.1.4.1 Foundation Loads. Foundation loads will be determined from the analysis and design of the superstructure and from the support of the equipment contained within the structure. The following loads will be considered:

- Dead loads
- Live loads
- Equipment and piping loads
- Wind loads
- Seismic loads

10B4.1.4.2 Induced Forces. Each building and associated major equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist any induced forces.

10B4.1.4.3 Structural System. The buildings will be designed as AISC Type 1 rigid frames or as Type 2 simple braced frame. For the purpose of resisting seismic lateral loads, the structure will be classified as a regular structure with a concentric braced frame, ordinary moment resisting frame, or special moment resisting frame in accordance with the definitions of Chapters 16 and 22 of the California Building Code.

10B4.1.4.4 Structural Criteria. The building steel frames will be designed and constructed using the materials and criteria set forth in Subsection 10B3.5, Steel and Other Metals.

Environmental loading will be determined in accordance with Section 10B3.1 Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads.

Seismic loading for the buildings will be calculated using equivalent lateral forces applied to the structure in accordance with the procedures of CBC Chapter 16.

The building foundations will be designed and constructed using reinforced concrete according to the criteria set forth in Subsection 10B3.4, Concrete. The foundation system will likely be comprised of a pile supported rigid mat. Foundation types will be controlled by depth of Young Bay mud at specific locations and will be verified by the project geotechnical investigation.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Allowable settlements
- Soil liquefaction potential
- Equipment, structure, and environmental loads
- Access and maintenance
- Equipment performance criteria

Load combinations and their respective allowable stresses will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.1.4.5 Analytical Techniques. The building foundations will be designed using static analysis techniques assuming a pile supported rigid mat. The mat will be sized such that the allowable settlement and bearing pressure/pile capacity criteria developed from a detailed subsurface investigation will not be exceeded assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the pile group loading coincides as nearly as possible with the resultant of the vertical loading. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively.

10B4.1.5 Gas Compressor Foundations

The gas compressor foundations will be designed to support the gas compressor and its components.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.1.5.1 Foundation Loads. Foundation loads will be furnished by the gas compressor manufacturer and will be superimposed with loads for the foundation itself. Typical loading data supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads from project specific criteria
- Seismic loads from project specific criteria
- Hydrostatic loads
- Temperature and pressure loads
- Dynamic operating loads
- Emergency loads such as turbine accident loads

10B4.1.5.2 Induced Forces

The gas compressor and associated equipment will be securely anchored to the foundation using cast-in-place steel anchor bolts or sleeved through-bolts designed to resist the equipment forces.

10B4.1.5.3 Structural Criteria. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Section 10B3.4, Concrete. The foundation system will likely be a rigid mat supported on piles or drilled caissons could be used. Final foundation system selection by the project geotechnical engineers will be based on specific test drillings at the major foundations upon completion of demolition.

The foundation design will address the following considerations:

- Soil bearing capacities and earth pressures
- Pile capacities
- Allowable settlements
- Soil liquefaction potential
- Equipment, structure, and environmental loads
- Natural frequencies of rotating equipment
- Access and maintenance
- Equipment performance criteria
- Dynamic effects of the rotating machinery

Environmental loading will be determined in accordance with, Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads.

Seismic loading to the foundation from the gas compressor will be calculated using equivalent lateral forces applied at the center-of-gravity of the equipment in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria for rigid equipment.

Load combinations and their respective strength factors for the foundation design will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.1.5.4 Analytical Techniques. The gas compressor foundation will be designed using static analysis techniques assuming a pile-supported rigid mat. The mat will be sized such that the allowable settlement and bearing pressure/pile capacity criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed as a combined footing assuming a linear vertical pressure distribution that is taken by the pile group. Pile loads shall be checked locally. The mat will be proportioned such that the resultant of the pile loads coincides as nearly as possible with the resultant of the vertical loading. The mat shall be reinforced to act as a pile cap spanning between piles. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively. The factor of safety on the pile shall be determined by the geotechnical engineer.

The gas compressor foundation will be checked for dynamic response of the operating combustion turbine. Manual calculations and simple computer models based on the fundamental principles of dynamic behavior of structures will be used to determine the natural frequencies of the support system. Where soil-structure interaction effects are important, low strain soil properties will be used to calculate soil springs using the procedures from *Vibrations of Soils and Foundation* by Richard, Hall, and Woods or a similar procedure. The concrete foundation will be analyzed as a rigid body on soil springs with the equipment modeled as a rigid mass located at its center of gravity and rigidly attached to the foundation. The foundation will be proportioned such that the principal natural frequencies will be at least 10 percent removed from the equipment operating speed.

Should the resulting foundation design prove to be uneconomical, the dynamic behavior of the foundation will be evaluated and compared to ISO 3945 Criteria for Vibration Severity. The resultant vibration level will be within the "Good" range of this standard.

A procedure for the dynamic analysis of large fan foundations supported by soil or piers, may be used to evaluate the dynamic behavior of the gas compressor foundations.

10B4.2 Tanks

10B4.2.1 Vertical, Cylindrical Field Erected Water Storage Tanks

The vertical, cylindrical, field erected water storage tanks will generally be of carbon steel construction with a protective interior coating.

The tank roof will be of the self-supported dome or cone type. The tank bottom will be ground supported, flat bottomed, with a slope of 1 percent. The tank will be provided with ladders, landing platforms, and handrails as required to provide access to all working areas. Vents, manholes, overflow piping, and grounding lugs will also be provided as necessary.

The typical foundation will consist of a pile supported rigid mat.

10B4.2.1.1 Foundation Loads. Foundation loads will be determined using project specific design criteria. The design of the tank and foundation will include the following loads:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Hydrodynamic loads

Foundation loading magnitudes from the tank will not exceed bearing allowables of the soil.

10B4.2.1.2 Induced Forces. The storage tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces in accordance with AWWA D100.

10B4.2.1.3 Structural System. The storage tanks will resist lateral loading through shear in the tank walls. Overturning will be resisted by anchor bolts connecting the tank wall to the foundation.

10B4.2.1.4 Structural Criteria. The foundation will be designed and constructed as a reinforced concrete ringwall using the criteria from Subsection 10B3.4, Concrete. The tank structures will be designed and constructed using the criteria established in AWWA D100.

Environmental loadings will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

Seismic loads will be determined in accordance with Subsection 10B3.6, Seismic Design Criteria, and AWWA D100, Section 13.

The seismic overturning moment will be determined from AWWA D100, Section 13.3.3.1, for a Seismic Zone 4. The structure coefficient will be determined from Table 16-P. The value of C1 will be determined from Section 13.3.3.1. The site amplification factor, S, will be determined from Table 17.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10, Load Combinations; Subsection 10B3.2.11, Allowable Stresses; and Section 3 of AWWA D100.

Design loads will be applied at the center of gravity of the tank. The design of the tank foundation will include the moment resulting from lateral displacement (hydrodynamics) of the tank contents in accordance with AWWA D100, Section 13.3.3.2.

Piping connections will be designed with a minimum 2 inches of flexibility in all directions as specified in AWWA D100, Section 13.5.

10B4.2.1.5 Analytical Techniques. The tank foundation will be designed using static analysis techniques of a pile supported rigid mat. The ringwall will be proportioned to resist the dead load of the tank and the overturning moment determined from AWWA D100. The ringwall will also be proportioned to resist maximum anchor bolt uplift force. Circumferential reinforcing steel hoops will be provided in the ringwall to develop the hoop stress produced by lateral soil pressure within the ringwall. The ringwall will be proportioned to resist the vertical gravity loads concurrent with the controlling lateral loads while maintaining a minimum 1.5 factor of safety against overturning. The factor of safety against sliding will be a minimum of 1.1.

The tank structure will be designed and proportioned such that during the application of any load, or combination of loads, the maximum stresses as stipulated in AWWA D100 will not be exceeded.

10B4.2.2 Horizontal, Cylindrical, Shop Fabricated Storage Tanks

The horizontal, cylindrical, shop fabricated tanks will be of carbon steel construction. The tanks will be provided with ladders, landing platforms, and handrails as required to provide access to all working areas. Each tank will be provided with a fill connection, fill drain, overflow, vent connections, manholes, and grounding lugs as necessary.

The foundations will be designed to resist the loadings imposed by the tanks and will be constructed of reinforced concrete.

10B4.2.2.1 Foundation Loads .Foundation loads will be furnished by the tank manufacturer and will be superimposed with loads for the foundation itself.

Typical loadings supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Hydrodynamic loads

10B4.2.2.2 Induced Forces. The tanks will be securely anchored to the foundation using cast-in-place steel anchor bolts designed to resist all induced forces.

10B4.2.2.3 Structural System. The tanks will be supported by integral legs or saddle supports designed to resist gravity and environmental loadings.

10B4.2.2.4 Structural Criteria. The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Subsection 10B3.4, Concrete. The foundation will likely be a rigid mat supported directly on bedrock or very dense controlled backfill. Only very light structures may be supported on shallow foundations. Foundation types will be controlled by depth of Young Bay mud at specific locations and will be verified by the project geotechnical investigation.

Environmental loadings will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the tank or tank component in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria.

Load combinations and their respective allowable strengths will be as indicated in Subsection 10B3.2.10, Load Combinations, and Subsection 10B3.2.11, Allowable Stresses.

10B4.2.2.5 Analytical Techniques. The tank foundations will be designed using static analysis techniques assuming a rigid mat. The mat will be sized such that the allowable settlement and bearing pressure criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the soil pressure coincides as nearly as possible with the resultant of the vertical loading. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively.

The tanks will be designed by a tank manufacturer in accordance with the ASME code, ANSI code, and the ASTM standards. Gravity and lateral loadings will be transferred to the foundation by integral legs or a saddle support system.

10B4.3 Equipment

10B4.3.1 Combustion Turbines

The combustion turbines and accessories will be designed to resist all design loads. The combustion turbine's enclosure and support frame will be constructed of carbon and alloy steels as required by the manufacturer's standards and shall meet all applicable codes and standards.

The foundations will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.3.1.1 Equipment Loads. Equipment loads will be determined by the manufacturer based on project performance criteria. Typical loadings used for design include the following.

- Dead loads
- Live loads
- Operating loads
- Construction loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Emergency loads such as turbine accident loads

10B4.3.1.2 Induced Forces. The combustion turbine and associated equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10B4.3.1.3 Structural Criteria. The combustion turbine and generator and accessories will be designed to resist project specific design loads and CBC specified loads.

Environmental loading will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads, multiplied by the appropriate pressure coefficient from Table No. 16-H of CBC.

The seismic loading and design of the combustion turbine and accessories will be in accordance with project specific criteria and CBC. Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the equipment or component in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria.

The inlet air filtration equipment and inlet air duct support structures shall be designed to resist the loading specified in CBC Chapter 16. For the purposes of resisting seismic lateral loads, the inlet air duct support structure will be classified as regular or irregular in accordance with the criteria established in CBC Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in CBC Chapter 16 and Subsection 10B3.6.1, Buildings and Structures.

Lateral forces on elements of structural and nonstructural components will be determined in accordance with CBC Section 1632, with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with CBC Table 16-O. These seismic forces will be combined with forces due to normal operating loads.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with CBC Table 16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections will remain in the elastic range.

10B4.3.1.4 Analytical Techniques. The combustion turbine and auxiliary equipment will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix 10. Stamps will be affixed to denote conformance to the appropriate codes.

10B4.3.2 Exhaust Ducting and SCR Catalyst

The exhaust ducting and SCR catalyst and accessories will be provided with platforms, stairways, and handrails as required to provide access for operations and maintenance.

The exhaust ducting and SCR catalyst and components will be designed to resist all design loads. The exhaust ducting and SCR catalyst and components will be constructed of carbon and alloy steels as required by the manufacturer's standards and shall meet all applicable codes and standards.

The foundation will be designed to resist the loadings furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.3.2.1 Equipment Loads. Equipment loads will be determined by the manufacturer and will be based on project performance criteria and applicable codes and standards. Typical loading used for design include the following:

- Dead loads
- Live loads
- Operating loads
- Construction loads
- Wind loads
- Seismic loads
- Hydrostatic loads
- Temperature and pressure loads

10B4.3.2.2 Induced Forces. The exhaust ducting and SCR catalyst and associated equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10B4.3.2.3 Structural Criteria. The exhaust ducting and SCR catalyst and associated equipment will be designed to resist project specific design loads and CBC specified loads.

Environmental loading will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads, multiplied by the pressure coefficients from Table No. 16-H of CBC.

The seismic loading and design of the exhaust ducting and SCR catalyst and associated equipment will be in accordance with project specific criteria and the CBC. Seismic loading will be calculated using equivalent lateral forces applied at the center of gravity of the equipment or component in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria. The exhaust ducting and SCR catalyst support structure will be designed to resist, at a minimum, the lateral forces specified in CBC Section 1634, Non-building structures and the applicable criteria of Subsection 10B3.6, Seismic Design Criteria.

For the purpose of resisting lateral seismic forces, the exhaust ducting and SCR catalyst support structure will be classified as regular or irregular in accordance with the criteria established in CBC Chapter 16. The procedures for the analysis of regular and irregular structures will be as specified in CBC Chapter 16 and, Subsection 10B3.6.1, Buildings and Structures.

Lateral forces on elements of structural and nonstructural components will be determined in accordance with CBC Section 1632 with Z equal to 0.4, I equal to 1.0 and ap and Rp in accordance with CBC Table 16-O.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with CBC Table16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections shall remain in the elastic range.

10B4.3.2.4 Analytical Techniques. The exhaust ducting and SCR catalyst and associated equipment will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix 10B and Appendix 10C. Stamps will be affixed to denote conformance to the appropriate codes.

10B4.3.3 Power Transformers

The power transformers, transformer equipment, material, and accessories will conform to the applicable standards of ANSI C57.12, NEMA TR1, ANSI/IEEE C59.94 and 98, and project specific criteria. The power transformer will be designed, fabricated, and tested in accordance with ANSI C57.12 series, NEMA TR 1, and project specific criteria.

The foundation will be designed to resist the loading furnished by the manufacturer and will be constructed of reinforced concrete.

10B4.3.3.1 Foundation Loads. Foundation loads will be furnished by the power transformer manufacturer and will be superimposed with loads for the foundation itself. Typical loadings supplied by the manufacturer include the following:

- Dead loads
- Live loads
- Wind loads
- Seismic loads

10B4.3.3.2 Induced Forces. The power transformers, transformer equipment, and accessories will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10B4.3.3.3 Structural System. The transformer will be regarded as a rigid body for foundation design purposes.

10B4.3.3.4 Structural Criteria. The power transformers, transformer equipment, and accessories will be designed to resist project specific design loads, CBC specified loads, and loads from applicable codes and standards.

The foundation will be designed and constructed as a monolithic reinforced concrete structure using the criteria from Appendix 10B, Subsection 10B4, Structural Design Methodology, and Subsection 10B3.4, Concrete. The foundation will likely be a pile supported rigid mat. The foundations will incorporate an interconnected integral containment basin capable of holding 110 percent of the transformer coolant contents prior to passage through an oil/water separator.

Environmental loading will be determined in accordance with Subsection 10B3.1, Natural Phenomena. Wind loads will be determined using the velocity pressures specified in Subsection 10B3.2.3, Wind Loads, multiplied by the appropriate pressure coefficients from CBC Table No.16-H.

The seismic loading and design of the power transformers, transformer equipment, accessories, and foundations will be in accordance with project specific criteria and CBC Chapter 16. Loading will be approximated using equivalent lateral forces applied to the center of gravity of the equipment or component using the criteria specified in Subsection 10B3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with Z equal to 0.4, I equal to 1.0, and ap and Rp in accordance with CBC Table 16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the foundation system will be designed for the same seismic load as the equipment. Load combinations will be as indicated in Subsection 10B3.2.10, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections will remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 10B3.2.11, Allowable Stresses.

10B4.3.3.5 Analytical Techniques. The power transformers, transformer equipment, and accessories will be designed and constructed in accordance with applicable requirements of codes and standards referenced in Appendix 10D, Electrical Engineering Design Criteria.

The power transformer foundation will be designed using static analysis techniques assuming a pile supported rigid mat. The mat will be sized such that the allowable settlements and bearing pressure or pile loading criteria developed from a detailed subsurface investigation will not be exceeded. The foundation will be analyzed assuming a linear soil pressure distribution. The mat will be proportioned such that the resultant of the pile loads coincides as nearly as possible with the resultant of the vertical loading. The minimum factors of safety against overturning and sliding will be 1.5 and 1.1, respectively.

10B4.3.4 Miscellaneous Equipment

Where possible, all miscellaneous equipment will be designed to project specific criteria. This miscellaneous equipment includes, but is not limited to, motor control centers, batteries, low voltage power and lighting systems, isolated bus ducts, pumps, lube oil cooling units, fire detection and protection systems, and switchgear. Standardized components such as motors, pumps, small fans, and other similar products that represent manufacturers' standard stock items will not be designed to meet project specific seismic loading criteria.

Miscellaneous equipment will meet all applicable codes and standards as well as the individual manufacturer's standards.

All equipment foundations and supports will be designed to resist project specific loading and the loading furnished by the equipment manufacturer.

10B4.3.4.1 Foundation Loads. Foundation loads will be furnished by the equipment manufacturers and will be superimposed with loads for the foundation itself. Typical loadings supplied by the manufacturer include the following.

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads (as applicable)

10B4.3.4.2 Induced Forces. All miscellaneous equipment will utilize steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment induced forces.

10B4.3.4.3 Structural System. Each individual piece of equipment will have its own unique structural system, and it is the responsibility of each manufacturer to assure its adequacy.

10B4.3.4.4 Structural Criteria. All miscellaneous equipment will be designed to resist project specific and CBC specified loads where possible and loads from applicable codes and standards.

The seismic loading and design of miscellaneous equipment will be in accordance with project specific criteria and CBC Chapter 16, if possible.

Seismic loading will be calculated using equivalent lateral forces applied to the center of gravity of the equipment or component in accordance with the criteria specified in Subsection 10B3.6, Seismic Design Criteria.

Lateral forces on equipment will be determined in accordance with CBC Section 1632 with Z equal to 0.4, I equal to 1.0, and a_p and R_p in accordance with CBC Table16-O. Equipment bases, foundations, support frames, and structural members used to transfer the equipment seismic forces to the main lateral load resisting system will be designed for the same seismic load as the equipment.

Load combinations will be as indicated in Subsection 10B3.2.10, Load Combinations. These load combinations are in addition to those normally used in design and those specified in applicable codes and standards. For all load combinations, including seismic, the stresses in the structural supporting members and connections shall remain in the elastic range. Structural allowable strengths will be as indicated in Subsection 10B3.2.11, Allowable Stresses.

10B4.3.4.5 Analytical Techniques. All miscellaneous equipment and accessories will be designed and constructed in accordance with applicable requirements of codes and standards.

All structural supports required for the miscellaneous equipment will be designed using static analysis techniques.

10B5 Hazard Mitigation

The project will be designed to mitigate natural and environmental hazards caused by seismic and meteorological events. This section addresses the structural design criteria used to mitigate such hazards.

10B5.1 Seismic Hazard Mitigation Criteria

Section 8.15 provides the description of the regional seismicity and the seismic risk associated with each of the major faults considering historical magnitude and probability of occurrence. The geologic hazards associated with these faults, when considered in concert with the results and recommendations of the future geologic investigation to be provided in a site-specific detailed geotechnical investigation, will be consistent with the design capabilities provided for the facility. The seismic design criteria are implemented through meeting the requirements of Seismic Zone 4 of the CBC.

Specific design features that will be incorporated into the plant to mitigate the identified seismic hazards include the following.

- Appropriate analysis techniques will be employed to calculate structure specific seismic loads.
- Plant structures, equipment, piping, and other components will be designed to resist the project specific seismic loads.
- All equipment will be positively anchored to its supporting structure. Nominal uplift capacity will be provided in the absence of calculated overturning forces.
- Anchorages will be designed to resist the project specific seismic loadings.
- Foundation systems will be selected and designed to minimize the effects of soil liquefaction.
- Adjacent structures will be seismically isolated from one another.

- Structural elements will be designed to comply with special detailing requirements intended to provide ductility.
- Connections for steel structures will have a minimum load carrying capability without regard to the calculated load.
- Lateral and vertical displacements of structures and elements of structures will be limited to specified values.
- The foregoing design features are intended to provide the following degrees of safety for structures and equipment:
  - Resist minor earthquakes without damage. Plant remains operational.
  - Resist moderate earthquakes without structural damage but with some nonstructural damage. Plant remains operational or is returned to service following visual inspection and/or minor repairs.
  - Resist major earthquakes without collapse but with some structural and nonstructural damage. Plant is returned to service following visual inspection and/or minor repairs.

10B5.2 Meteorological and Climatic Hazard Mitigation

Meteorological and climatic data will form the design basis for the project. Portions of the data and the design bases that pertain to structural engineering have been provided in this Appendix.

Specific design features that will be incorporated into the plant to mitigate meteorological and climatic hazards include the following:

- Structures and cladding will be designed to resist the wind forces.
- Sensitive structures will be designed for wind induced vibrational excitation.
- Roofs will be sloped and equipped with drains to prevent accumulation of rainfall.
- Plant mechanical and electrical equipment will be placed on elevated equipment bases when required.
- The plant site will be graded to convey runoff away from structures and equipment.

The foregoing design features will be incorporated in accordance with applicable codes and standards identified in this Appendix.

The degree of safety offered by these features is consistent with the requirements of the applicable codes and standards and the economic benefits these features provide.

10B6 References

American Concrete Institute (ACI). 2001. The California Building Code.

American Iron and Steel Institute (AISI). 2001. "North American Specification for the Design of Cold-Formed Steel Structural Members."

American Iron and Steel Institute (AISI). 2002. "Cold-Formed Steel Design Manual Parts I-VII."

Applied Technology Council. 1982. "Tentative Provision for the Development of Seismic Regulations for Buildings." December.

California Building Code (CBC). 2001. City of San Francisco

Specification for Structural Steel Buildings. 1989. Allowable Stress Design and Plastic Design. June.

Structural Engineers Association of California. 1999. "Recommended Lateral Force Requirements and Commentary."

Uniform Plumbing Code (UPC). 2000.

APPENDIX 10C

Mechanical Engineering Design Criteria

APPENDIX 10C

Mechanical Engineering Design Criteria

10C1 Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of mechanical engineering systems for the project. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement specification and construction specifications as required by the California Energy Commission (CEC).

10C2 Codes and Standards

The design of the mechanical systems and components will be in accordance with the laws and regulations of the federal government, state of California, and industry standards. The current issue or revision of the documents, at the time of the filing of this AFC will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirements shall apply.

The following codes and standards are applicable to the mechanical aspects of the power facility.

- California Building Code
- California Mechanical Code
- California Plumbing Code
- ASME Boiler and Pressure Vessel Code
- ASME/ANSI 133.1 Power Piping Code
- ASME Performance Test Codes
- ASME Standard TDP-1
- ANSI B16.5, B16.34, and B133.8
- American Gear Manufacturers Association (AFMA)
- Air Moving and Conditioning Association (AMCA)
- American Petroleum Institute (API) – except for electrical requirements
- American Society for Testing and Materials (ASTM)
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- American Welding Society (AWS)
- Cooling Tower Institute (CTI)
- Heat Exchange Institute (HEI)
- Manufacturing Standardization Society (MSS) of the Valve and Fitting Industry
- National Fire Protection Association (NFPA)

10C3 Mechanical Engineering General Design Criteria

10C3.1 General

The systems, equipment, materials, and their installation that will be designed in accordance with the applicable codes; industry standards; and local, state, and federal regulations, as well as the design criteria; manufacturing processes and procedures; and material selection, testing, welding, and finishing procedures specified in this section.

Detailed equipment design will be performed by the equipment vendors in accordance with the performance and general design requirements specified by the Engineering, Procurement, and Construction contractor. Equipment vendors will be responsible for using construction materials suited for the intended use.

Asbestos will not be used in the materials and equipment supplied. Flanges manufactured in the People's Republic of China will be prohibited from use on any mechanical equipment. Where feasible, materials will be selected to withstand the design operating conditions, including expected ambient conditions, for the design life of the plant. It is anticipated that some materials will require replacement during the life of the plant due to corrosion, erosion, etc.

10C3.2 Pumps

Pumps will be sized in accordance with industry standards. Where feasible, pumps will be sized for maximum efficiency at the normal operating point. Pumps will be designed to be free from excessive vibration throughout the operating range.

10C3.3 Tanks

Large outdoor storage tanks will not be insulated.

Overflow connections and lines will be provided. Maintenance drain connections will be provided for complete tank drainage.

Manholes, where provided, will be at least 18 inches in diameter and hinged to facilitate removal. Storage tanks will have ladders and cleanout doors as required to facilitate access/maintenance. Provisions will be included for proper tank ventilation during internal maintenance.

10C3.4 Heat Exchangers

Heat exchangers will be provided as components of mechanical equipment packages and may be shell-and-tube or plate type. Heat exchangers will be designed in accordance with Tubular Exchanger Manufacturers Association (TEMA) or manufacturer's standards. Fouling factors will be specified in accordance with TEMA.

10C3.5 Pressure Vessels

Pressure vessels will include the following features/appurtenances:

- Process, vent, and drain connections for startup, operation, and maintenance

- Materials compatible with the fluid being handled
- A minimum of one manhole and one air ventilation opening (e.g., handhole) where required for maintenance or cleaning access
- For vessels requiring insulation, shop-installed insulation clips spaced not greater than 18 in. on center
- Relief valves in accordance with the applicable codes

10C3.6 Piping and Piping Supports

Stainless steel pipe may be Schedule 5S or 10S where design pressure permits. Underground piping may be high-density polyethylene (HDPE) where permitted by code, operating conditions, and fluid properties. In general, water system piping will be HDPE where embedded or underground and carbon steel where aboveground.

Threaded joints will not be used in piping used for lubricating oil, and combustion turbine generator (CTG) natural gas service. Natural gas piping components will not use synthetic lubricants. Victaulic, or equal, couplings will be used for low energy aboveground piping, where feasible.

Piping systems will have high point vents and low point drains. Drains with restricting orifices or traps with startup and blowdown drains and strainers/crud traps will be installed in low points of steam lines where condensate can collect during normal operation.

Hose and process tubing connections to portable components and systems will be compatible with the respective equipment suppliers' standard connections for each service.

Stainless steel piping will be used for the lubricating oil system.

An air gap between the recycled water and potable water systems at the recycled water storage tank shall per the California requirements for recycled water use and preclude contact between the two systems.

10C3.7 Valves

10C3.7.1 General Requirements

Valves will be arranged for convenient operation from floor level where possible and, if required, will have extension spindles, chain operators, or gearing. Hand-actuated valves will be operable by one person.

Valves will be arranged to close when the handwheel is rotated in a clockwise direction when looking at the handwheel from the operating position. The direction of rotation to close the valve will be clearly marked on the face of each handwheel.

The stops that limit the travel of each valve in the open or closed position will be arranged on the exterior of the valve body. Valves will be fitted with an indicator to show whether they are open or closed; however, only critical valves will be remotely monitored for position.

Valve materials will be suitable for operation at the maximum working pressure and temperature of the piping to which they are connected. Steel valves will have cast or forged steel spindles. Seats and faces will be of low friction, wear-resistant materials. Valves in throttling service will be selected with design characteristics and of materials that will resist erosion of the valve seats when the valves are operated partly closed.

Valves operating at less than atmospheric pressure will include means to prevent air in-leakage. No provision will be made to repack valve glands under pressure.

10C3.7.2 Drain and Vent Valves and Traps

Drain traps will include air cock and easing mechanism. Internal parts will be constructed from corrosion-resistant materials and will be renewable.

Trap bodies and covers will be cast or forged steel and will be suitable for operating at the maximum working pressure and temperature of the piping to which they are connected. Traps will be piped to drain collection tank or sumps and returned to the cycle if convenient.

10C3.7.3 Low Pressure Water Valves

LP water valves will be the butterfly type of cast iron construction. Cast iron valves will have cast iron bodies, covers, gates (discs), and bridges; the spindles, seats, and faces will be bronze. Fire protection valves will be UL-approved butterfly valves meeting NFPA requirements.

10C3.7.4 Instrument Air Valves

Instrument air valves will be the ball type of bronze construction, with valve face and seat of approved wear-resistant alloy.

10C3.7.5 Nonreturn Valves

Nonreturn valves in vertical positions will have bypass and drain valves. Bodies will have removable access covers to enable the internal parts to be examined or renewed without removing the valve from the pipeline.

10C3.7.6 Motor-Actuated Valves

Motor-actuated valves will be fitted with both hand and motor operating gear. The hand and motor actuation mechanisms will be interlocked so that the hand mechanism is disconnected before the motor is started.

Motor actuators will include torque switches to stop the motor automatically when the valve gate has reached the "full open" or "full closed" position.

The motor actuator will be placed in a position relative to the valve that prevents leakage of liquid, steam, or corrosive gas from valve joints onto the motor or control equipment.

10C3.7.7 Safety and Relief Valves

Safety valves and/or relief valves will be provided as required by code for pressure vessels, heaters, and boilers. Safety and relief valves will be installed vertically. Piping systems that can be over-pressurized by a higher-pressure source will also be protected by pressure relief valves. Equipment or parts of equipment that can be over-pressurized by thermal expansion of the contained liquid will have thermal relief valves.

10C3.7.8 Instrument Root Valves

Instrument root valves will be specified for operation at the working pressure and temperature of the piping to which they are connected.

10C3.8 Heating, Ventilating, and Air Conditioning

HVAC system design will be based on site ambient conditions specified in Section 1.0.

Except for the HVAC systems serving the control room and administration areas, the systems will not be designed to provide comfort levels for extended human occupancy.

Air conditioning will include both heating and cooling of the inlet filtered air. Air velocities in ducts and from louvers and grills will be low enough not to cause unacceptable noise levels in areas where personnel are normally located.

Fans and motors will be mounted on anti-vibration bases to isolate the units from the building structure. Exposed fan outlets and inlets will be fitted with guards. Wire guards will be specified for belt-driven fans and arranged to enclose the pulleys and belts.

Air filters will be housed in a manner that facilitates removal. The filter frames will be specified to pass the air being handled through the filter without leakage.

Ductwork, filter frames, and fan casings will be constructed of mild steel sheets stiffened with mild steel flanges and galvanized. Ductwork will be the sectional bolted type and will be adequately supported. Duct joints will be leak-tight.

Grills and louvers will be of adjustable metal construction.

10C3.9 Thermal Insulation and Cladding

Parts of the project requiring insulation to reduce heat loss or afford personnel safety will be thermally insulated. Minimum insulation thickness for hot surfaces near personnel will be designed to limit the outside lagging surface temperature to a maximum of 140 °F, based on 80 °F ambient temperature and 1 mph/hr air velocity. Other insulation minimums will be designed to limit the heat loss to approximately 80 Btu/hr-ft^2 based on an 80 °F ambient condition and an air velocity of 20 mph/hr.

The thermal insulation will have as its main constituent calcium silicate, foam glass, fiberglass, or mineral wool, and will consist of pre-formed slabs or blankets, where feasible. Asbestos materials will be prohibited. An aluminum jacket or suitable coating will be provided on the outside surface of the insulation. Where a hard-setting compound is used as an outer coating, it will be nonabsorbent and noncracking. Thermal insulation will be chemically inert even when saturated with water. Insulation system materials, including jacketing, will have a flame spread rating of 25 or less when tested in accordance with ASTM E 84.

Insulation at valves, pipe joints, or other points to which access may be required for maintenance will be specified to be removable with a minimum of disturbance to the pipe insulation. At each flanged joint, the molded material will terminate on the pipe at a distance from the flange equal to the overall length of the flange bolts to permit their removal without damaging the molded insulation.

Above ground insulated piping will be clad with pebbled or corrugated aluminum of not less than 30 mm thick and frame-reinforced. At the joints, the sheets will be sufficiently overlapped and corrugated to prevent moisture from penetrating the insulation.

Design temperature limits for thermal insulation will be based on system operating temperature during normal operation.

Outdoor and underground insulation, if required, will be moisture resistant.

10C3.10 Testing

Hydrostatic testing, including pressure testing at 1.5 times the design pressure, will be specified and performed for pressure boundary components where an in-service test is not feasible or permitted by code.

10C3.11 Welding

Welders and welding procedures will be certified in accordance with the requirements of the applicable codes and standards before performing any welding. Contractor will maintain indexed records of welder qualifications and weld procedures.

10C3.12 Painting

Except as otherwise specified, equipment will receive the respective manufacturer's standard shop finish. Finish colors will be selected from among the paint manufacturer's standard colors.

Finish painting of uninsulated piping will be limited to that required by OSHA for safety or for protection from the elements.

Piping to be insulated will not be painted.

10C3.13 Lubrication

The types of lubrication specified for facility equipment will be suited to the operating conditions and will comply with the recommendations of the equipment manufacturers.

The initial startup charge of flushing oil will be provided by the equipment manufacturer and will be the manufacturer's standard lubricant for the intended service. Subsequently, such flushing oil will be sampled and analyzed to determine whether it can also be used for normal operation or must be replaced in accordance with the equipment supplier's recommendations.

Rotating equipment will be splash lubricated, force lubricated, or self-lubricated. Oil cups will be provided as necessary. Where automatic lubricators are fitted to equipment, provision for emergency hand lubrication will also be specified. Where applicable, equipment will be designed to be manually lubricated while in operation without the removal of protective guards. Lubrication filling and drain points will be readily accessible.

APPENDIX 10D

Electrical Engineering Design Criteria

APPENDIX 10D

Electrical Engineering Design Criteria

10D1 Introduction

This appendix summarizes the codes, standards, criteria, and practices that will be generally used in the design and construction of electrical engineering systems for the facility. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement, and construction specifications as required by the California Energy Commission (CEC).

10D2 Codes and Standards

The design of the electrical systems and components will be in accordance with the laws and regulations of the federal government, State of California and industry standards. The current issue or revision of the documents at the time of the filing of this Application for Certification (AFC) will apply, unless otherwise noted. If there are conflicts between the cited documents, the more conservative requirement shall apply.

The following codes and standards are applicable to the electrical aspects of the power facility.

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- California Electrical Code (CEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories, Inc. (UL)

10D3 Switchyard and Transformers

10D3.1 Switchyard

The switchyard will be located on the west end of the site and will interconnect to PG&E's nearby Potrero substation with aboveground aerial cables or with underground cables depending upon the final design interface with PG&E. The switchyard will be of the air-insulated aluminum bus type and will consist of high voltage SF_6-insulated dead-tank circuit breakers arranged in a ring-bus configuration. Connections to the ring bus nodes will be provided for each generator and for the inter-ties to the utility grid. Each circuit breaker will be equipped with a no load break, air-insulated, disconnect switch on each side. An isolating disconnect switch will also be installed in each generator transformer connection to the ring bus to allow continuous ring integrity when a transformer is out of service. Air-insulated tubular aluminum bus will be used as the primary bus construction and interconnection material within the switchyard. The buses will be attached to post insulator columns on structural steel supports.

Current and voltage transformers will be located at points within the switchyard to provide for metering and relaying.

Control, protection and monitoring for the switchyard will be located in the switchyard relay room of the electrical building. Monitoring and alarms will be available to the DCS operator workstations in the control room. All protection and circuit breaker control will be powered from the station battery-backed 125 Vdc system.

The switchyard design will meet the requirements of the National Electrical Safety Code—ANSI C2.

A grounding grid will be provided to control step and touch potentials in accordance with IEEE Standard 80, Safety in Substation Grounding. All equipment, structures and fencing will be connected to the grounding grid of buried copper conductors and ground rods, as required. The substation ground grid will be tied to the plant ground grid.

Lightning protection will be provided by shield wires and/or lightning masts for any overhead lines. The lightning protection system will be designed in accordance with IEEE 998 guidelines.

All faults shall be detected, isolated, and cleared in a safe and coordinated manner as soon as practical to insure the safety of Equipment, Personnel, and the Public. Protective relaying will meet IEEE requirements and will be coordinated with PG&E's requirements.

The ring bus will be provided with over-lapping high impedance differential relay systems. The protection will be designed to maintain ring bus integrity when isolating a faulted node. Each outgoing line to the utility substation 115-kV bus will be provided with redundant high-speed relay systems with transfer trip capability. Each circuit breaker will be provided with independent breaker failure relay protection scheme. Breaker failure protection will be accomplished by protective and timing relays for each breaker. Each high voltage breaker will have 2 redundant trip coils.

Interface with PG&E's supervisory control and data acquisition (SCADA) system will be provided. Interface will be at the interface terminal box and RTU. Communication between the facility switchyard and the control building to which it is connected will be included.

Revenue metering will be provided on the 115-kV outgoing lines recording net power to or from the PG&E switchyard (bi-directional). The revenue meters and a metering panel will be located in the switchyard relay room.

10D3.2 Transformers

Each generator will be connected to the 115kV switchyard through a separate 13.8-kV to 115-kV step-up transformer and a generator 15 kV metal-clad vacuum circuit breaker. The step-up transformers will be designed in accordance with ANSI standards C57.12.00, C57.12.90, and C57.116. The transformers will be two-winding, delta-wye, ONAN/ONFA/ONAF, 65°C rise. The neutral point of the HV winding wye-connected winding will be solidly grounded. Each main step-up transformer will have metal oxide surge arrestors adjacent to the HV terminals and will have manual de-energized ("no-load") tap changers located in the HV windings.

Facility power will be supplied through unit auxiliary transformers connected to two of the 13.8-kV generator output busses. Two two-winding, delta-wye 13.8-kV to 4.16-kV transformers with low-impedance grounding resistors will be provided.

APPENDIX 10E

Control Engineering Design Criteria

APPENDIX 10E

Control Engineering Design Criteria

10E1 Introduction

This appendix summarizes the codes, standards, criteria and practices that will be generally used in the design and installation for instrumentation and controls for the facility. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement specification and construction specifications as required by the California Energy Commission (CEC).

10E2 Codes and Standards

The design specification of all work will be in accordance with the laws and regulations of the federal government and the state of California. A summary of general codes and industry standards applicable to design and construction follows.

- American National Standards Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- The Institute of Electrical and Electronics Engineers (IEEE)
- Instrument Society of America (ISA)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- American Society for Testing and Materials (ASTM)

10E3 Control Systems Design Criteria

10E3.1 General Plant Control Philosophy

An overall distributed control system (DCS) will be used as the top-level supervisor and controller for the project. DCS operator workstations will be located in the control room of the Administration and Control Building. The intent is for the plant operator to be able to completely run the entire plant from a DCS operator station, without the need to interface to other local panels or devices. The DCS system will provide appropriate hard-wired signals to enable control and operation of all plant systems required for complete automatic operation.

Each combustion turbine generator is provided with its own microprocessor based control system with both local and remote operator workstations, installed on the turbine-generator control panels and in the remote main control room, respectively. All of the functions and controls available on the turbine-generator operator workstations will be replicated on the DCS operator work stations.

Several of the larger packaged subsystems associated with the project include their own PLC based dedicated control systems. For larger systems that have dedicated control systems, the DCS will function mainly as a monitor, using network data links to collect, display, and archive operating data.

Pneumatic signal levels, where used, will be 3 to 15 psig for pneumatic transmitter outputs, controller outputs, electric-to-pneumatic converter outputs, and valve positioner inputs.

Instrument analog signals for electronic instrument systems shall be 4 to 20 ma dc.

The primary sensor full-scale signal level, other than thermocouples, will be between 10 mV and 125 V.

10E3.2 Pressure Instruments

In general, pressure instruments will have linear scales with units of measurement in pounds per square inch gauge.

Pressure gauges will have either a blowout disk or a blowout back and an acrylic or shatterproof glass face.

Pressure gauges on process piping will be resistant to plant atmospheres.

Pressure test points will have isolation valves and caps or plugs. Pressure devices on pulsating services will have pulsation dampers.

10E3.3 Temperature Instruments

In general, temperature instruments will have scales with temperature units in degrees Fahrenheit. Exceptions to this are electrical machinery RTDs and transformer winding temperatures, which are in degrees Celsius.

Dial thermometers will have 4-1/2- or 5-inch-in-diameter (minimum) dials and white faces with black scale markings and will be every-angle type and bimetal actuated. Dial thermometers will be resistant to plant atmospheres.

Temperature elements and dial thermometers will be protected by thermowells except when measuring gas or air temperatures at atmospheric pressure. Temperature test points will have thermowells and caps or plugs.

RTDs will be either 100 ohm platinum or 10 ohm copper, ungrounded, three-wire circuits (R_{100}/R_0-1.385). The element will be spring-loaded, mounted in a thermowell, and connected to a cast iron head assembly.

Thermocouples will be single-element, grounded, spring-loaded, Chromel-Constantan (ANSI Type E) for general service. Thermocouple heads will be the cast type with an internal grounding screw.

10E3.4 Level Instruments

Reflex-glass or magnetic level gauges will be used. Level gauges for high-pressure service will have suitable personnel protection.

Gauge glasses used in conjunction with level instruments will cover a range that is covered by the instrument. Level gauges will be selected so that the normal vessel level is approximately at gauge center.

10E3.5 Flow Instruments

Flow transmitters will be the differential pressure type with the range matching the primary element. In general, linear scales and charts will be used for flow indication and recording.

In general, airflow measurements will be temperature-compensated.

10E3.6 Control Valves

Control valves in throttling service will generally be the globe-body cage type with body materials, pressure rating, and valve trims suitable for the service involved. Other style valve bodies (e.g., butterfly, eccentric disk) may also be used when suitable for the intended service.

Valves will be designed to fail in a safe position.

Control valve body size will not be more than two sizes smaller than line size, unless the smaller size is specifically reviewed for stresses in the piping.

Control valves in 600-class service and below will be flanged where economical. Where flanged valves are used, minimum flange rating will be ANSI 300 Class.

Severe service valves will be defined as valves requiring anticavitation trim, low noise trim, or flashing service, with differential pressures greater than 100 psid.

In general, control valves will be specified for a noise level no greater than 90 dBA when measured 3 feet downstream and 3 feet away from the pipe surface.

Valve actuators will use positioners and the highest pressure, smallest size actuator, and will be the pneumatic-spring diaphragm or piston type. Actuators will be sized to shut off against at least 110 percent of the maximum shutoff pressure and designed to function with instrument air pressure ranging from 60 to 125 psig.

Handwheels will be furnished only on those valves that can be manually set and controlled during system operation (to maintain plant operation) and do not have manual bypasses.

Control valve accessories, excluding controllers, will be mounted on the valve actuator unless severe vibration is expected.

Solenoid valves supplied with the control valves will have Class H coils. The coil enclosure will normally be a minimum of NEMA 4 but will be suitable for the area of installation. Terminations will typically be by pigtail wires.

Valve position switches (with input to the DCS for display) will be provided for MOVs and open/close pneumatic valves. Automatic combined recirculation flow control and check valves (provided by the pump manufacturer) will be used for pump minimum-flow recirculation control. These valves will be the modulating type.

10E3.7 Instrument Tubing and Installation

Tubing used to connect instruments to the process line will be 3/8- or 1/2-inch-outside-diameter copper or stainless steel as necessary for the process conditions.

Instrument tubing fittings will be the compression type. One manufacturer will be selected for use and will be standardized as much as practical throughout the plant.

Differential pressure (flow) instruments will be fitted with three-valve manifolds; two-valve manifolds will be specified for other instruments as appropriate.

Instrument installation will be designed to correctly sense the process variable. Taps on process lines will be located so that sensing lines do not trap air in liquid service or liquid in gas service. Taps on process lines will be fitted with a shutoff (root or gauge valve) close to the process line. Root and gauge valves will be main-line class valves.

Instrument tubing will be supported in both horizontal and vertical runs as necessary. Expansion loops will be provided in tubing runs subject to high temperatures. The instrument tubing support design will allow for movement of the main process line.

10E3.8 Pressure and Temperature Switches

Field-mounted pressure and temperature switches will have either NEMA Type 4 housings or housings suitable for the environment.

In general, switches will be applied such that the actuation point is within the center one-third of the instrument range.

10E3.9 Field-Mounted Instruments

Field-mounted instruments will be of a design suitable for the area in which they are located. They will be mounted in areas accessible for maintenance and relatively free of vibration and will not block walkways or prevent maintenance of other equipment. Freeze protection will be provided.

Field-mounted instruments will be grouped on racks. Supports for individual instruments will be prefabricated, off-the-shelf, 2-inch pipestand. Instrument racks and individual supports will be mounted to concrete floors, to platforms, or on support steel in locations not subject to excessive vibration.

Individual field instrument sensing lines will be sloped or pitched in such a manner and be of such length, routing, and configuration that signal response is not adversely affected.

Local control loops will generally use a locally mounted indicating controller (pressure, temperature, flow, etc.).

Liquid level controllers will generally be the nonindicating, displacement type with external cages.

10E3.10 Instrument Air System

Branch headers will have a shutoff valve at the takeoff from the main header. The branch headers will be sized for the air usage of the instruments served, but will be no smaller than 3/8 inch. Each instrument air user will have a shutoff valve and filter at the instrument.

APPENDIX 10F

Chemical Engineering Design Criteria

APPENDIX 10F

Chemical Engineering Design Criteria

10F1 Introduction

This appendix summarizes the codes, standards, criteria and practices that will be generally used in the design and installation for chemical engineering systems for the Facility. More specific project information will be developed prior to construction of the project to support detailed design, engineering, material procurement specification and construction specifications as required by the California Energy Commission (CEC).

10F2 Design Codes and Standards

The design and specification of all work will be in accordance with the laws and regulations of the federal government and the state of California. Industry codes and standards partially unique to chemical engineering design to be used in design and construction are summarized below:

- ANSI — American National Standards Institute
- ANSI B31.1 — Power Piping Code
- ASME — American Society of Mechanical Engineers
- ASME — Performance Test Code 31, Ion Exchange Equipment
- ASTM — American Society for Testing and Materials
- ASTM D859-94 — Referee Method B for Silica as SiO_2
- ASTM D888-96 — Referee Method A for Dissolved Oxygen
- ASTM D513-96 — Referee Method D for CO_2
- OSHA — Occupational Safety and Health Administration
- SSPC — Steel Structures Painting Council Standards
- SSPC SP3 — Power Tool Cleaning
- SSPC SP7 — Brush-Off Blast Cleaning
- SSPC SP1 — Solvent Cleaning
- SSPC SP6 — Commercial Blast Cleaning
- SSPC SP5 — White Metal Blast Cleaning
- UL — Underwriters Laboratories
- AWWA — American Waterworks Association
- WWA 2540-95 — Method C for TDS

Other recognized standards will be used as required to serve as design, fabrication, and construction guidelines when not in conflict with the above listed standards.

The codes and industry standards used for design, fabrication, and construction will be the codes and industry standards, including all addenda, in effect as stated in equipment and construction purchase or contract documents.

10F3 General Criteria

10F3.1 Design Water Quality

10F3.1.1 Circulating Water

Recycled water produced by the recycled water treatment facility at the ERP will supply the project with circulating water makeup. Data from the City of San Francisco Southeast Wastewater Treatment Plant (SEWWTP) indicate that the effluent from the recycled water treatment facility will have the characteristics defined in Subsection 8.14, Water Resources.

10F3.1.2 Service Water

Recycled water from the recycled water treatment facility will be used to supply the project with all general service water requirements such as non-potable sanitary as well as process needs.

A typical water analysis range for this water is presented in Subsection 8.14.

10F3.1.3 Water Treatment

Recycled water from the recycled water treatment facility will be supplied to the plant Water Treatment System. The high quality effluent from the Water Treatment System will serve as injection water to the gas turbine NOx reduction system. In addition, treated water will be used also to supply water for turbine power augmentation, turbine water wash, and various uses during unit startup.

Treated water will be the highest quality practical. Minimum quality requirements will be as follows.

- Total dissolved solids – 3mg/l
- Silica as SiO_2 – 0.1 mg/l
- Specific conductance at demineralizer effluent – 0.5 μS/cm
- pH – 6.5 to 7.5

10F3.1.4 Construction Water

Water for use during construction will be supplied from the City of San Francisco's potable water system.

10F3.1.5 Fire Protection Water

The source of water for fire protection will be from a connection to the City's fire water system located in 25th Street.

10F3.2 Chemical Conditioning

10F3.2.1 Circulating Water System Chemical Conditioning

Circulating water chemical conditioning will consist of chemicals to minimize corrosion and to control the formation of mineral scale and biofouling. Corrosion and scaling will be controlled by the use of sulfuric acid for alkalinity adjustment in conjunction with inhibitors, as required, for scale and corrosion control. Chlorination utilizing sodium hypochlorite will be used to minimize biofouling of the cooling tower.

10F3.3 Chemical Storage

10F3.3.1 Storage Capacity

Chemical storage tanks will, in general, be sized to store a minimum of 1.5 times the normal bulk shipment. The minimum acceptable volume of the SCR aqueous ammonia storage tank will provide at least 3 days storage.

10F3.3.2 Containment

Chemical storage tanks containing corrosive or hazardous fluids will be surrounded by curbing. Curbing and drain piping design will allow a full tank capacity spill without overflowing the curbing. For multiple tanks located within the same curbed area, the largest single tank will be used to size the curbing and drain piping.

10F3.3.3 Closed Drains

Waste piping for volatile liquids and wastes with offensive odors will use closed drains to control noxious fumes and vapors.

10F3.3.4 Coatings

Tanks, piping, and curbing for chemical storage applications will be provided with a protective coating system. The specific requirements for selection of an appropriate coating will be identified prior to equipment and construction contract procurements.

10F3.4 Wastewater Treatment

Any plant process wastewaters will be collected in the plant wastewater collection system for offsite discharge. Plant effluent to be discharged offsite will meet all applicable criteria of federal, state, and local permits.

Sanitary wastewater will be collected and sent to the city sanitary sewer system through a connection to the line in Cesar Chavez Street.

APPENDIX 10G

Geologic and Foundation Design Criteria

APPENDIX 10G

Geologic and Foundation Design Criteria

10G1 Introduction

This appendix includes the results of past documentation regarding subsurface investigation, and geotechnical assessment for the project to support the Application for Certification (AFC).

This appendix contains a description of the site conditions, and preliminary foundation-related subsurface conditions. Soil related hazards addressed include soil liquefaction, hydrocompaction (or collapsible soils), and expansive soils. Preliminary foundation and earthwork considerations are based on general published information available for the project area including recent geotechnical investigations for the adjacent MUNI Metro East property, and established geotechnical engineering practices. During the preparation of the Design Build Specification, a detailed geotechnical investigation will be conducted to address the subsurface soil conditions in order to develop site-specific and detailed design conditions.

Information contained in this appendix reflects the codes, standards, criteria and practices generally used in the design and construction of site and foundation engineering systems for the facility. More specific project information will be developed during execution of the project to support detailed design, engineering, material procurement, and construction specifications.

10G2 Site Conditions

The site is located near the intersection of 25th Street and Michigan Street. The site topography is relatively flat. Elevations range from 13 to about 15 feet above sea level. The site currently drains towards the bay. The area is generally flat terrain with no permanent structures.

10G3 Site Subsurface Conditions

10.G3.1 Stratigraphy

Generalized stratigraphy is discussed in Section 8.15, Geologic Hazards and Resources. Borings will be performed at the project site to verify the soil consistency and characteristics.

10G3.2 Seismicity/Ground Shaking

The project site is subject to the probability of seismic activities. No known faults traverse through the local soils in or near the site. The San Francisco Bay occupies a wide linear northwest trending structural depression within the Coast Range Geomorphic Province of northern California. The depression, called the San Francisco Bay – Santa Clara Valley

(SFB-SCV) depression, is bounded by the Santa Cruz Mountains to the southwest and the East Bay Hills and Diablo Range to the northeast. The Coastal Range Province consists of sedimentary, metamorphic, volcanic, and igneous rocks predominately ranging in age from the Jurassic/Cretaceous to recent.

Within the San Francisco Bay are located two major fault systems in a historically active tectonic setting—the San Andreas Fault in the west and the Hayward fault in the east. The project site is located approximately 3 miles east of the San Andrea Fault and about 14 miles west of the Hayward Fault.

SFERP is located within the San Francisco Marin Structural Block, bounded on the east by the Hayward fault and on the west by the San Andreas Fault. During the last two million years, the San Francisco Block has tilted with its eastern portion subsiding to form the elongate depression now occupied by the San Francisco Bay. During the same period, the Santa Cruz Mountains, Diablo Range, and Berkeley Hills have been uplifted.

The bedrock of the San Francisco Block consists of Jurassic-Cretaceous rock, belonging to the Franciscan Assemblage and Great Valley sequence. These rocks include graywacke sandstone, conglomerate, chert, serpentinite, cataclasite, and altered volcanics of the Franciscan Assemblage and sandstone and shale of the Great Valley Sequence.

Previous studies and test borings performed at the adjacent MUNI Metro East and Operation Center site indicate the presence of man-made fill and Young Bay Mud underlain by Bay sand and Old Bay Mud.

The project site is susceptible to ground shaking during major earthquakes from the San Andreas or Hayward Faults. The seismic risk to structures depends upon the distance to the epicenter, the characteristics of the earthquake, the geologic, groundwater, and the soil conditions underlying the structures. The site is located in Seismic Zone 4.

10G3.3 Ground Rupture

Ruptures along the surface trace of a fault tend to occur along lines of previous faulting. There is no evidence of potentially active fault trace at the nearby site; and thus the primary hazard of surface rupture at the project site is expected to be negligible. However, a ground rupture study at the project site will be undertaken as part of the site geotechnical investigations in support of the engineering design to verify this assumption.

10G3.4 Groundwater

Groundwater occurs at approximately 5 to 10 feet below ground surface. The groundwater table has to be determined and verified at the project site. The assessment will be undertaken as part of the geotechnical investigation described in the introduction.

10G4 Assessment of Soil-Related Hazards

10G4.1 Liquefaction

Soil liquefaction is a process by which loose, saturated, granular deposits lose a significant portion of their shear strength due to pore water pressure buildup resulting from cyclic loading, such as that caused by an earthquake. Soil liquefaction can lead to foundation bearing failures and excessive settlements when:

- The design ground acceleration is high
- The water level is relatively shallow
- Low SPT blow counts are measured in granular deposits (suggesting low soil density)

Previous investigations indicated primarily fill and Bay Mud overlying bedrock, with fill being relatively thick in areas but containing proportions of rubble and debris.

10G4.2 Expansive Soils

Soil expansion is a phenomenon by which clayey soils expand in volume as a result of an increase in moisture content, and shrink in volume upon drying. Expansive soils are usually identified with index tests, such as percentage of clay particles and liquid limit. It is generally accepted that soils with liquid limits larger than about 50 percent, i.e., soils that classify as high plasticity clays (CH) or high plasticity silts (MH), may be susceptible to volume change when subjected to moisture variations.

Previous data indicates that fill and Bay Mud overburden soils will exhibit no expansive properties.

10G4.3 Collapsible Soils

Soil collapse (hydrocompaction) is a phenomenon that results in relatively rapid settlement of soil deposits due to addition of water. This generally occurs in soils having a loose particle structure cemented together with soluble minerals or with small quantities of clay. Water infiltration into such soils can break down the interparticle cementation, resulting in collapse of the soil structure. Collapsible soils are usually identified with index tests, such as dry density and liquid limit, and consolidation tests where soil collapse potential is measured after inundation under load.

Based on the available data, the potential for soil collapse at the site is expected to be remote. This will be verified by testing of the soil samples retrieved from the detailed geotechnical investigation described in the introduction.

10G5 Preliminary Foundation Considerations

10G5.1 General Foundation Design Criteria

For satisfactory performance, the foundation of any structure must satisfy two independent design criteria. First, it must have an acceptable factor of safety against bearing failure in the foundation soils under maximum design load. Second, settlements during the life of the structure must not be of a magnitude that will cause structural damage, endanger piping connections or impair the operational efficiency of the facility. Selection of the foundation type to satisfy these criteria depends on the nature and magnitude of dead and live loads, the base area of the structure and the settlement tolerances. Where more than one foundation type satisfies these criteria, then cost, scheduling, material availability and local practice will probably influence or determine the final selection of the type of foundation.

An evaluation of the information collected for the AFC indicates that no adverse foundation-related subsurface and ground water conditions would be encountered that would preclude the construction and operation of the proposed structures. The site can be considered suitable for development of the proposed structures contingent upon completion of a detailed geotechnical investigation to support of the engineering design, and using the information to address the preliminary foundation and earthwork considerations discussed in this appendix.

10G5.2 Shallow Foundations

Completion of the geotechnical investigation will determine whether proposed light structures can be supported directly on the fill. Shallow foundation construction will require the earthwork measures discussed in Subsection 10G6, Preliminary Earthwork Considerations.

The decision on whether or not to employ shallow-bearing foundations to support the lighter plant components would also be based on the uniformity, strength, compressibility, and thickness of the fill and Bay Mud overlying the bedrock. If some very slight structures might be placed on shallow foundations, allowable bearing pressures will include a factor of safety against bearing capacity failure of at least 3.0. Tolerable total settlements are expected to be limited to about 1 inch and differential settlement between adjacent structures generally less than 0.5 inch. Aboveground steel water tanks can tolerate several times those magnitudes.

Footings for small/light structures are sized according to allowable bearing capacity and certain construction standards. On sandy soils, a degree of confinement is required to develop bearing capacity. Thus, minimum widths of about 2 feet for wall footings and 3 feet for isolated column footings are generally specified even through the full allowable bearing capacity may not be reached under very light loading.

10G5.3 Deep Foundations

Both the variable thickness and low consistency (low strength and high compressibility) of fill and the Bay Mud deposits suggest that a deep foundation consisting of piles or caissons may be required to support virtually all heavy components of the SFERP.

A foundation report will be issued which addresses foundation selection and installation particular to the soil conditions under the major components. The character of the fill material, and range of thickness from a few feet up to 26 feet, also dictate that the method of installation and pile type selection for the deep foundation account for variable lengths and obstructions which present hard driving conditions. The overburden soils will probably contribute very little reliable side-support or skin friction component to a pile foundation at this site. The SPT values obtained in the fill are not reliable as a measure of soil consistency if the fill contains construction debris and random common fill dumped in an uncontrolled fashion.

A necessary component of selecting and installing deep foundations is the design and implementation of a pile test program particular to the pile type, required loading, and bearing material. Since test borings may not define the full range of soil conditions at a site, nor lab testing measure strength of all soil involved, test piles are driven/installed at several locations on site prior to production driving. Through use of full-scale load tests or PDA (pile driving analyzer) testing, the estimated load capacity of a singular pile can be verified or adjusted as necessary, often measuring both end bearing and friction components.

Under most conditions, the factor of safety against bearing capacity failure must be at least 2.0 for deep foundations. When high lateral and uplift loads are important (the stack as an example), the testing program is also designed to measure this performance as well. Load-deflection curves are used for lateral capacity verification, and uplift or pull-out tests measure skin friction performance alone, usually designed for a factor of safety of at least 3.0. Individual pile capacities are adjusted for group effects based on pile center-to-center spacings and soil strength moduli.

Liquefaction potential can affect foundation performance even for deep foundations that extend through the liquefiable soils to firm strata below. Liquefaction is a temporary quick condition, which reduces the strength of submerged granular soils to virtually zero. Under this condition, the side or skin friction support on piles can be temporarily lost, and the pile foundation must be designed to derive added load capacity through extra embedment or tip dimension.

10G5.4 Corrosion Potential and Ground Aggressiveness

Corrosivity tests will be conducted to determine whether the site soils to be non-corrosive or corrosive for buried steel based on the chloride content and pH values.

10G6 Preliminary Earthwork Considerations

10G6.1 Site Preparation and Grading

Site grading may include (1) removal of existing deleterious materials and (2) fill to bring the site to a final grade. The site fill work should be performed as detailed below. All soil surfaces to receive fill should be proof rolled with a heavy vibratory roller or a fully loaded dump truck to detect soft areas.

10G6.2 Temporary Excavations

It is anticipated that confined temporary excavations at the site will be required during construction. All excavations should be sloped in accordance with OSHA requirements. Sheet piling could also be used to support any excavation. The need for internal supports in the excavation will be determined based on the final depth of the excavation. Any excavation below the water table should be dewatered using well points installed prior to the start of excavation.

10G6.3 Backfill Requirements

All fill material must be free of organic matter, debris or clay balls, with a maximum size not exceeding 2 inches. Structural fill must also be well graded and granular. Granular material with similar specifications can be used for pipe bedding, except that the maximum size should not exceed 0.5 inch.

Structural fill should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557 when used for raising the grade throughout the site, below footings or mats, or for rough grading. Fill placed behind retaining structures may be compacted to 90 percent of the maximum dry density as determined by ASTM D 1557. Initially, structural fill should be placed in lifts not exceeding 8 inches loose thickness. Thicker lifts may be used pursuant to approval based on results of field compaction performance. The moisture content of all compacted fill should fall within 3 percentage points of the optimum moisture content measured by ASTM D 1557, except compact the top 12 inches of subgrade to 95 percent of ASTM D 1557 maximum density.

Pipe bedding can be compacted in 12-inch lifts to 90 percent of the maximum dry density as determined by ASTM D 1557. Common fill to be placed in remote and/or unsurfaced areas may be compacted in 12-inch lifts to 85 percent of the maximum dry density as determined by ASTM D 1557.

10G7 Inspection and Monitoring

A California-registered Geotechnical Engineer or Engineering Geologist will monitor geotechnical aspects of foundation construction and/or installation, and fill placement. At a minimum the Geotechnical Engineer/Engineering Geologist will monitor the following activities:

- All surfaces to receive fill should be inspected prior to fill placement to verify that no pockets of loose/soft or otherwise unsuitable material were left in place and that the subgrade is suitable for structural fill placement.
- All fill placement operations should be monitored by an independent testing agency. Field compaction control testing should be performed regularly and in accordance with the applicable specification to be issued by the Geotechnical Engineer.
- The Geotechnical Engineer must witness all pile load testing and initial stages of production pile installation.
- Settlement monitoring of significant foundations and equipment is recommended on at least a quarterly basis during construction and the first year of operation, and then semi-annually for the next 2 years.

10G8 Site Design Criteria

10G8.1 General

The project will be located in the City and County of San Francisco, California. The approximate 4-acre site is relatively flat, with no permanent structures. The site would be accessible from 25th Street or Cesar Chavez Street.

10G8.2 Datum

The site grade varies between 13 to 15 feet, mean sea level, based on the elevation of the adjacent MUNI Metro East site. Final site grade elevation will be determined.

10G9 Foundation Design Criteria

10G9.1 General

Reinforced concrete structures (spread footings, mats and deep foundations) will be designed consistent with Appendix 10B.

Allowable soil bearing pressures for foundation design will be in accordance with this appendix.

10G9.2 Groundwater Pressures

Hydrostatic pressures due to groundwater or temporary water loads will be considered.

10G9.3 Factors of Safety

The factor of safety for structures, tanks and equipment supports with respect to overturning, sliding, and uplift due to wind and buoyancy will be as defined in Appendix 10B, Structural Engineering Design Criteria.

10G9.4 Load Factors and Load Combinations

For reinforced concrete structures and equipment supports, using the strength method, the load factors and load combinations will be in accordance with Appendix 10B, Structural Engineering Design Criteria.

10G10 References

California Building Code. 2001.